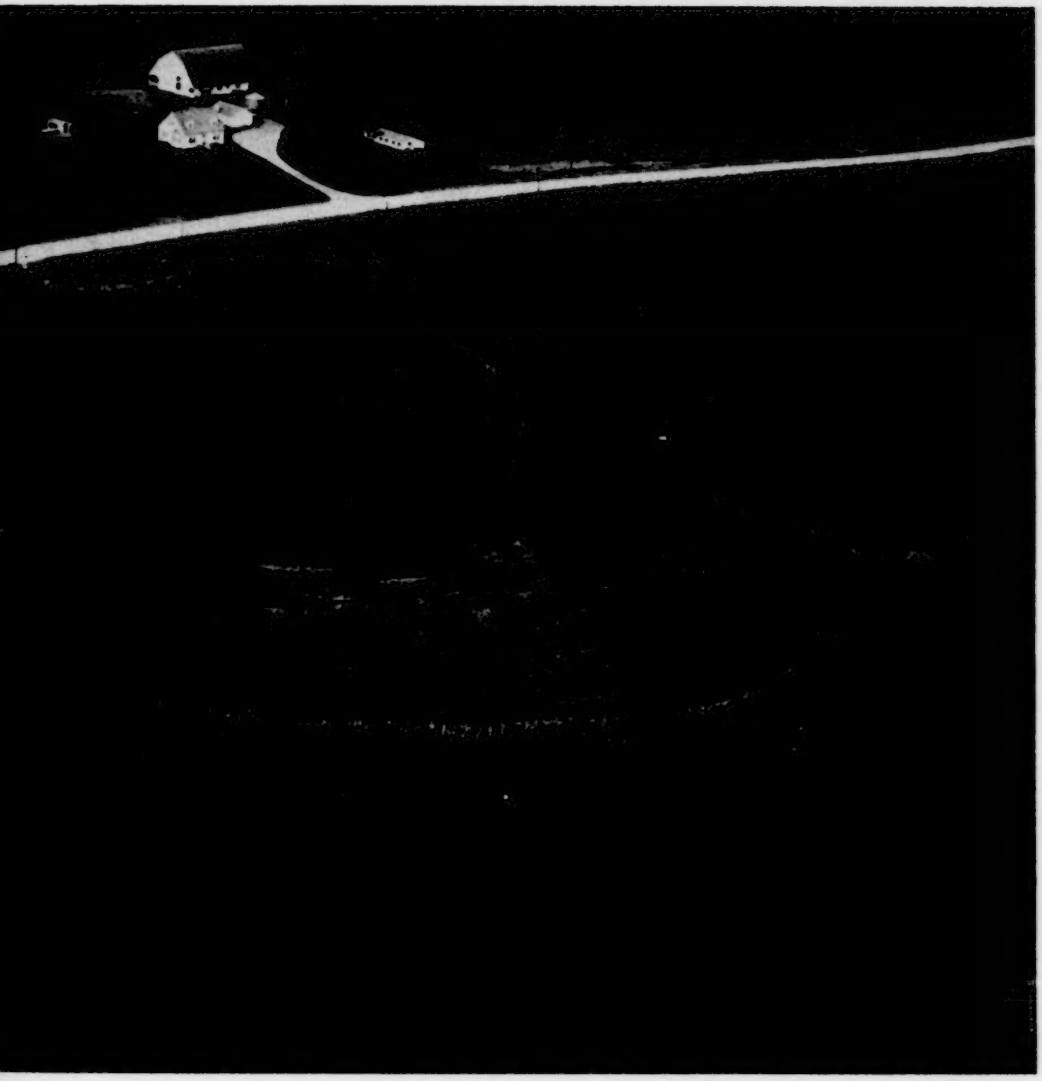


Volume 16, No. 5
September-October
1961

Wise Land Use—
A National Goal

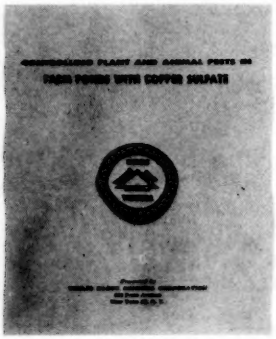
River Basin Planning

Population Growth
and Soil Conservation

Resources of the Sea

Effects of Windbreaks
on Adjacent Crops

how to overcome plant and animal pests in farm ponds



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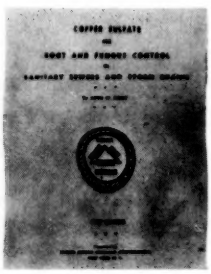

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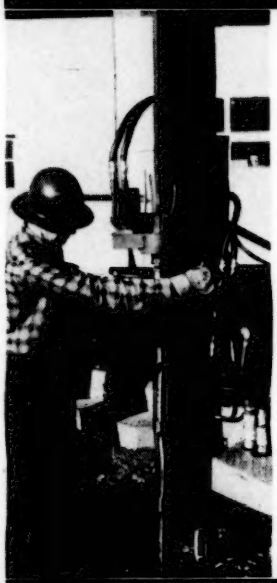

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COVER: The Arlie Tillotson farm near Prole, Iowa, exemplifies Conservation farming at its best. This farm was the 1958 sweepstakes winner in the Soil Conservation Awards Program sponsored by the Des Moines Register and Tribune and the Iowa Farm and Home Register. *Des Moines Register Photo*

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THE SOCIETY IN ACTION!

The Council of the Soil Conservation Society of America, (left to right) Elmer Sauer, A. L. Patrick, D. J. Sacco, George Browning, W. J. Huddleston, Howard Barrows, N. R. Richards, H. Wayne Pritchard, Walter Gumbel, Roy Hockensmith, Harold Rhodes, Herbert Hopper, Minott Silliman, Jr., E. D. Bolton and Bernard Geraghty.

THE SIXTEENTH Annual Meeting of the *Society*, held on the campus of Purdue University, was attended by 1,400 persons. Official registrants numbered 745; others in attendance were wives and families of registrants. All meetings, including the 12 sessions held simultaneously on Monday afternoon, had sizeable audiences. The facilities at Purdue University are excellent for this type of a meeting.

Purdue faculty members, farmers, and farm organization people joined *Society* members to hear Secretary of Agriculture Orville Freeman deliver his first major conservation talk since assuming his present office. Approximately 4,000 people listened to the famous Purdue Glee Club while the Secretary, who left his Washington desk at 5:00 P.M., circled the airport in a private plane from Chicago; the plane landed at 8 P.M. and Freeman was on the stage shortly thereafter. After holding a late press conference, he returned immediately to Chicago where he boarded a plane to Washington the next morning.

Society members who heard Secretary Freeman were impressed with his knowledge of conservation programs and his dedication to championing the cause of Agriculture.

The entire conference program, developed under the leadership of Frank H. Mendell, chairman of the Program Committee, was well received and there was considerable audience participation. Several of the outstanding papers presented will be carried in future issues of the JOURNAL. Copies of all papers presented will be mailed to meeting registrants soon. Others may secure a set of the papers by writing to the *Society's* Des Moines office; $1.50 for each complete set desired should be enclosed with the request.

Hoosier hospitality was much in evidence as *Society* members from Indiana in their green vests and black ties sought to make everyone feel at home. Their wives, adorned with aprons matching their husbands' vests, were delightful hostesses. Mrs. Rosemary Murphy of Kentland, Indiana, "Mrs. America of 1961," greeted *Society* members at the elaborate chicken barbecue served as a courtesy of the Hoosier Chapter *SCSA*.

Harry Galloway of Lafayette, a Purdue staff member, served effectively as chairman of the Local Arrangements Committee. Robert Whitsitt of Indianapolis, a state staff member of the Soil Conservation Service for Indiana, is Hoosier Chapter Chairman. Registrants have been voicing their appreciation for a pleasant and profitable meeting to the Hoosier Chapter members by letter and in person.

Council Decisions

"If every member of the *Society* could attend a meeting of the Council, he would return home a better member. He couldn't help but be impressed with the scope of activities, the important programs, and the dedication of the individuals serving the *Society* just because they believe in the work it is doing," thus spoke I. O. Hembre of Wisconsin, chairman of the *Society's* Chapter Activities Committee after he had attended the recent Council meeting held in conjunction with the annual meeting.

Council members will probably not question the "dedication" attribute after spending three days (and nights) at the discussion table—missing a chance to play golf on the famous Purdue course, sweltering in the summer heat of the Cornbelt, and working with concern for the program of the *Society*.

The scope of the *Society* program is such that reporting it through a JOURNAL column is most difficult. It is almost impossible to convey to the members of the *Society* who were not present to observe the discussions an account that will explain in detail the work of the organization. We hope that the following brief account will give members some insight into the activities and decisions made by the Council.

In his report to the Council, President Gumbel called for up-dating of the *Society's* administrative practices as related to committees and their assignments, use of the vice presidents and other members of the Council for committee supervision, and more complete reporting by these groups as an aid to future committees. He urged the employment of additional staff at the earliest opportunity, thus allowing more assistance to chapters and committees, and more representation in the national conservation arena. It was also his suggestion that ways be found to

(Continued on page 237)

(Lower left) The Northern Illinois Chapter delegation at the Society's 16th annual meeting proudly displays the Sweepstakes Banner won by the chapter in the Chapter Activities Contest. (Lower right) The Kentucky delegation at the 16th annual meeting. (Right) Symposia and technical committee meetings enjoyed "full houses" during their sessions.

"An integrated conservation program brings direct, present, tangible benefits for the whole community in the form of better recreational opportunities, added industry and jobs, new business enterprises, better farms, protected soil resources, and freedom from perennial damage of floods." In these words United States Secretary of Agriculture, Orville L. Freeman, described the advantages of soil and water conservation planning and action programs to members of the Soil Conservation Society of America. This article is the text of Secretary Freeman's July 31 address at the Sixteenth Annual Meeting of the Society held at Purdue University, Lafayette, Indiana.

I LIKE THE WAY your Society's objective is stated. "Advancement of the science and art of good land use" expresses in a phrase the national, twentieth-century approach to man's oldest and most fundamental occupation—the quest for food. Happily for us, that quest has ended in an abundance of food unparalleled anywhere in any time; in our society the science and the art of good land use has flourished and advanced to undreamed of levels of production.

But in the lexicon of human disaster, the word famine is not yet obsolete. Even in this age of the scientific break-through, even as man reaches out to new planets, three-fourths of the people on this planet still struggle day in and day out to get enough to eat. For them the quest for food remains infinitely more important than the conquest of space.

And yet today, for the first time in all history, it lies within man's power to banish the specter of hunger forever from the earth. This we have demonstrated. In our free system, initiative and skill have combined with science and technology to prove that the end of man's quest for food—the ultimate goal of enough-to-go-around—is at least in sight. The achievements of American agriculture in the science and the art of good land use beckon the imagination, challenge the initiative, and sustain the hope of peoples everywhere.

Orville L. Freeman, sixteenth United States Secretary of Agriculture, served as Governor of Minnesota for three terms. He early demonstrated a vital interest in soil and water conservation and in his capacity as Governor, Freeman dedicated the East Willow Creek Watershed project in Fillmore County, Minnesota. The photograph at the top of this page is similar to one displayed by Freeman in his Washington, D.C., office and shows a portion of the East Willow Creek watershed.

But like the prophet without honor in his own country, the American farmer, I fear, is vastly under-valued in his own America. And on this I can give you some specifics:

- In 1960, when the per capita income of our non-farm population averaged $2,282, the per capita income of farm people averaged $986—and that included government payments and income from outside sources!
- With factory workers earning an average $2.29 per hour, farm labor brought only 82 cents per hour!
- During the past 10 years when agriculture increased its production 29 percent, agricultural income *decreased* 26 percent!

This is only a fragment of the sorry story told by the cold statistics of farm income, but it will serve to illustrate the fact that the American farmer, for all his dramatic success in the science of agriculture, is a very low man indeed on the economic totem pole.

Agriculture in the National Economy

It is high time the vast urban majority in our industrial society get the facts straight about the dwindling agricultural minority whose productive genius enables this nation to be better fed and better clothed than any other in the world. Let me mention some more specifics:

1 In a society that glorifies efficiency, the farmer in the last 10 years has increased his output at an annual rate of 6.2 percent; the rate in non-agricultural industries was 2.9 percent. Output per man hour in agriculture in 1960 was more than three times what it was in 1940, and almost double what it was in 1950. Last year, one farm worker produced food enough for 26 people; 20 years ago he produced enough for about 11.

In short, while the farmer ranks down at the bottom on the index of income, when it comes to productivity, he is at the top. This is a paradox that defies logic and mocks at fairness.

2 Here I am talking straight to Mrs. Housewife, who tends to blame the farmer for the big bill she pays at the supermarket counter for a basket-full of essentials—including, incidentally, lipstick, paper products, imported sardines, furniture polish, and volume III of a new encyclopedia. The plain fact is that Mrs. Housewife today gets more food for her money than she did 10 years ago. Why? Because the rise in farm productivity has moderated the rise in retail prices of food and fiber.

True, the cost of food has risen 20 percent since 1947-49, but the cost of all other items in the cost of living index has risen 30 percent. Transportation costs have gone up 46 percent; housing 31.5 percent; medical care, 56 percent.

What the household budget-keeper doesn't realize is that the retail cost of her typical market basket of U. S. farm grown foods, excluding the imported sardines and coffee, has risen only 12 percent while marketing costs have gone up 36 percent. She doesn't understand, I feel sure, that the farmer's share of the dollar she spends for U. S. grown foods has decreased 22 percent since 1949.

3 I would remind industry and business that the farmer spends $25 to $26 billion a year for equipment, goods and services needed to produce the country's food and fiber. He and his family spend another $15 billion a year for ordinary living items—everything from teacups to TVs.

Farmers buy $2.5 to $3 billion worth of tractors, machinery equipment, and motor vehicles a year. They spend $3.5 billion for fuel, lubricants, and maintenance and another $1.5 billion for lime and fertilizer. Every year agriculture uses products containing enough rubber to put tires on 6 million cars and more electric power than Baltimore, Chicago, Boston, Detroit and Houston combined.

Four out of every ten jobs in private employment are related to agriculture. Ten million people work at storing, transporting, processing and merchandising agricultural products and another six million work at producing the supplies farmers use.

Does anyone need a slide-rule to work out the correlation between the economic welfare of agriculture and the economic welfare of the Nation as a whole?

Conservation and Agricultural Policy

If you are wondering what all this has to do with conservation, let me say that it has everything to do with it. I believe that conservation is a matter of people as well as principles and practices. If we are concerned with the conservation of resources, we must begin, it seems to me, with concern for the people who use those resources—the people who are, in a sense, their custodians in our time.

These are the farmers and ranchers of America—who own and use 1.1 billion acres of cropland and pasture, rangeland and woods, upland and lowland, marsh and mountainside, that make up the thousands of watersheds which make up the hundreds of river basins that add up to most of the precious resources of soil and water, forest and wildlife that we are determined to conserve.

I make this point, quite frankly, because I believe it is incumbent upon you and me to look at the problem of land use and resource conservation in human as well as technical terms. Intrinsically and inseparably, what we call the "farm problem" is part and parcel of the conservation problem. Until we have dealt with one, we shall not fully succeed in dealing with the other.

We know that good land use pays off, but we also know that it costs money. A direct correlation between farm income and the individual farmer's willingness to adopt and continue sound land use practices is clearly reflected by the experience of the Soil Conservation Service. An agriculture harassed by sub-standard levels of income—with all that that implies in terms of priorities of outlay—is less likely to be willing, or able, to use the land as it should be used.

As I see it then, we must come to grips with the physical problems of land use, the economics of production adjustment and farm income, and the social necessities of rural rehabilitation, as a totality, conscious of the intimate interrelationship between them.

Agricultural policy must look not only to balanced supply and demand and higher levels of farm income, but to better use of the land and allied resources. Conservation policy must look not only to better use of land and water, but to more efficient and rewarding farming. Both policies must merge in programs designed to relieve or eliminate rural areas of chronic distress, to enlarge and improve facilities for recreation, to harness our rivers against floods, and to provide for orderly urban and industrial expansion.

In this light, conservation takes its place in the mainstream of national action. It becomes a dynamic force affecting not only the nation's future but the nation's present.

Water Resources Planning Act

This concept of the function of conservation underlies the far-reaching proposals put before Congress by the President just 2 weeks ago in the Water Resources Planning Act of 1961. These proposals represent an imaginative, immediate, and wholly practical approach to the development, and conservation use of the nation's water and related land resources on a river-basin scale.

I am sure that I need not explain to this audience the increasing urgency of our national water situation in light of the many new and often conflicting demands of agriculture, industry, commerce, urban expansion and recreation. The rich water resources of this country that once seemed virtually inexhaustible are no longer any more than adequate. Indeed, without the most careful protection and wisest use, they could be less than that. Today, as the President has pointed out, we use 300 billion gallons of water every day, much of it wastefully. By 1980, we will need 600 billion gallons a day. The obvious answer is conservation and the river basin program will prove, I believe, to be the right approach.

It will be my responsibility to represent Agriculture on the Water Resources Council to be set up under the pending legislation. Other members are the Secretary of Interior, the Secretary of the Army, and the Secretary of Health, Education and Welfare. Together, it will be our function, as stated in the proposed Act, "to establish principles, standards and procedures for the preparation of regional or river basin plans, and for the formulation and evaluation of Federal water resources projects."

The Act also authorizes the President to create River Basin Commissions to coordinate Federal, state and local plans for the development of water and related land resources in any region, river basin, or group of river basins.

I believe the creation of the Cabinet-level Council, combined with the establishment of River Basin Commissions, will provide long-needed machinery for ending the fragmentation of authority and responsibility among Federal, state, and local agencies which has impeded any orderly attack on the nation's increasingly critical problem of water supply.

I call your attention to the fact that the Council as well as the Commissions will deal not only with water but with related land resources; and I assure you here and now that the importance of land use measures in the contributory watersheds will not be overlooked in the development of river basin programs.

On the contrary, the river-basin approach will give new impetus and significance to the conservation functions of the Forest Service, the watershed protection program of the Soil Conservation Service, and the work of the 3,000 soil conservation districts whose evolution from an idea to a network of local mechanisms covering four-fifths of the land area of the country has been one of the most astonishing and gratifying phenomena of social action in the last quarter century.

A Conservation Program on the Land

Just how effective that role can be is illustrated by the experience of the little town of Culpeper, Virginia, a few miles from Washington. I want to relate what has happened there; as I do so, I hope you will keep in mind what I have said earlier about the interrelationship between conservation and rural rehabilitation, water development, recreation and other values.

Culpeper was harassed by the dual problems of an unreliable water supply and recurrent floods that caused thousands of dollars damage annually to roads, streets, bridges and other improvements in and about the town.

The town fathers joined with the local soil conservation district and applied to the Department of Agriculture for technical and financial help in carrying out a watershed project. Costs were shared by the town, the farmers in the watershed, and the Federal Government.

The project called for an intensified conservation program on the farms and woodlands of the watershed, plus a system of three earthen dams on tributaries upstream of the town. Two of these dams were purely

for flood prevention, catching flood peaks and releasing water gradually in a flow that the stream channel could handle safely.

The third dam served several purposes. In addition to checking floods, it provided permanent storage for about half-a-year's supply of water, which could be released to supplement the town's regular supply.

Now completed, the project has produced these results:

- A 75-acre lake behind the storage dam has added a tremendous recreational asset to the community.
- The assurance of a stable water supply has encouraged three new industries employing some 500 people to locate in Culpeper.
- Bottom land in the city that was formerly worthless because of periodic flooding, is now the site of a thriving shopping center.
- Farm lands in the watershed are marked by improved pastures and woodlands, grassed waterways and strip-cropped fields—visible evidences of a conservation program tailored to fit the needs of each field.

In short, an integrated conservation program at Culpeper has brought direct, present, tangible benefits in the form of better recreational opportunities for the community as a whole, added industry and jobs, new business enterprises, better farms, protected soil resources, and freedom from the perennial damage of floods. Projected into a national focus, integrated planning and action can produce much the same results for the country as a whole.

I know that the Culpeper story has been duplicated in other watersheds and other towns and other soil conservation districts through the country. On the wall of my office in Washington hangs a picture of the East Willow Creek Watershed in southeastern Minnesota where, as Governor of Minnesota several years ago, I had the honor, and the educational experience, of dedicating the soil conservation project.

The Job Ahead

But do other people know the Culpeper and the East Willow Creek stories? Does the American public generally understand that this kind of conservation pays off in practical values today as well as in the future? I do not think it does. We have an enormous job of education to do before the millions of people in the cities of this country understand what conservation really means to them as well as to their children.

I would remind you that the "advancement of the science and the art of good land use" is going to depend increasingly on the comprehension and support of men and women whose contact with the land is insulated by layers of asphalt and concrete.

These are the people who, in the last analysis, will determine the future of conservation in this country. Their understanding of the values involved and their appreciation of the present and future economic and social rewards will be the decisive factor in maintaining a forward-moving, adequately-financed conservation program. They have a right to ask questions; they deserve answers; and it is up to us to produce the facts that lead to understanding.

The public is entitled to know how we justify the expenditure of sizeable sums of money—its money—to improve land use and conserve soil when we are already up to the ears in surplus crops. I doubt that it will be satisfied with the answer that it makes no more sense to abandon conservation than it does to abandon polio research because we have plenty of vaccine, or to abandon higher education because we have an abundance of college graduates.

The American public wants to know, in rather precise terms, just what they are getting for their conservation dollar, what the return will be for unit of input. They think, and they should think, in the practical terms of the cost-benefit ratios. Our job is to provide the answer in terms of dollars and cents—cold economics—wherever and whenever we can.

Finally, I want to say to you as emphatically as I can that the Secretary of Agriculture and every member of his Department is deeply conscious of his responsibility in this important area of national action. We stand ready, within the limits of our resources and authority, to support and assist the kind of local initiative you represent. The tools of research, education, technical assistance, credit and cost-sharing are at your disposal. Use them.

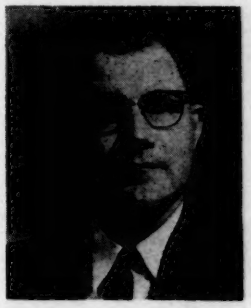
The position of the administration is unequivocal. One of President Kennedy's first messages to the Congress dealt with the problem of resource use and conservation. It has been followed by the recent message on water resources. We mean to project and carry forward a driving campaign to assure this Nation that its heritage of rich resources will not be squandered.

I would like to close with a word of appreciation and tribute to the men and women—you men and women—who have made conservation a living reality in this country and a model for the world. You constitute the surest bulwark against the spoliation of the country's basic wealth. Surely no finer or more competent corps of conservation scientists and technicians exists anywhere, and your deeds, you may be sure, have meaning not only for America but for the world.

In the last thirty years, great strides forward have been made. Momentum has built up; it must not be allowed to dissipate. On the contrary, it must be increased, and it will be. I know the deep conviction of the President. I assure you of my own. I am confident of yours. Together we are going to forge ahead!

Population Growth, Resource Productivity and Soil Conservation

JOHN F. TIMMONS



Two major forces influencing soil conservation are the growth of population and the productivity of resources generated by technology. Interpretations of the effects of these forces suggest fundamental changes in the nature and content of soil conservation. This article is the first part of a thought provoking analysis presented by the author at the Sixteenth Annual Meeting of the Soil Conservation Society of America. The second part will appear in the November issue of the Journal.

TEN YEARS AGO, the United States Department of Agriculture predicted the "fifth plate" would soon alleviate the problem of farm surpluses in this Nation. Today, everyone must be well aware that the Nation has larger food surpluses with 183 million people than we had in 1950 with 150 million people. What happened to the fifth plate? It materialized; but man's knowledge in the use of our resources provided food not only for the fifth plate but also for a sixth plate which has not yet been set by population growth. United States farmers could and would gladly provide food for even a seventh plate if permitted. Furthermore, a recent University of Minnesota study concludes that food surpluses would be even larger if people would reduce their food intake in the interest of living longer (*9*). This point is corroborated by experiences of life insurance companies in paying out death benefits.

On the international scene, science and reason reveal that the world faces serious problems of feeding, clothing, housing and caring for the population increases which lie ahead. But science and reason also reveal solutions to these problems. It remains for mankind to use his energies in finding and in implementing these solutions rather than dissipating his energies toward what G. K. Chesterton lampooned as cutting off heads to assure a distribution of hats.

This approach is nothing new. Ever since man was evicted from the Garden of Eden, he has had to earn his bread by the sweat of his brow in keeping with God's decree to Adam and Eve and all their descendants. This decree remains in effect and no change is in sight. The road ahead for man is not an easy one; serious roadblocks may test his patience and ingenuity to the limit.

However, the almost 3 billion people on earth today enjoy higher levels of living than did their ancestral nomads and cave men. The 183 million people in the United States today are much better endowed with this world's goods than were the 3 million Indians inhabiting the North American Continent when Columbus arrived. Today, the world's productivity of material goods, on a per capita as well as on an aggregate basis, is greater than ever before. This increased productivity has been generated by man's industry in using his energies of mind and body. And his present knowledge could, if applied, increase substantially the world's productivity.

Sordid evidence indicates that man has upon many occasions, throughout his existence, created materials substantially beyond needs for subsistence and these he has used wastefully and shamelessly in waging war. Through ignorance, selfishness, and institutional restrictions, man has wasted natural resources. However, assurance is given by modern technology that man has scarcely scratched the surface of the world's potential productivity, but providing for the material needs of his growing numbers is a tremendous challenge for all mankind. Unprecedented mental and physical energy must be expended in unlocking nature's secrets through research and in applying this knowledge through technological and institutional innovations.

Malthusian Reasoning

Reacting against the exuberant reasoning of William Godwin who felt that mankind was entering a Golden Age in which his food supply would be produced in a few flower pots, Thomas Robert Malthus wrote his famous book *An Essay on the Principle of Population as It Affects the Future Improvement of Society* in 1798.

John F. Timmons is professor of economics at the Iowa State University. *This article is taken from the author's address on August 1, 1961, at the Sixteenth Annual Meeting of the Soil Conservation Society of America. It is Journal Paper No J-4183 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project Number 1094.*

Malthus (*7*) began his argument with two postulata. First, food is necessary to the existence of man. Second, the passion between the sexes is necessary and will continue so. His major argument was, "Assuming, then, my postulata as granted, I say, that the power of population is indefinitely greater than the power in the earth to produce subsistence for man."[1]

According to Malthus, population is held down to the level of subsistence by two kinds of checks. Positive checks, including famine, disease and war, reduce the number of people already born and thus indirectly reduce future births to a level which can be accommodated by the level of subsistence. Preventive checks, including delayed marriage and continence during marriage, reduce births to a number of people that can be supported by the earth's resources.

In 1803, Malthus published an enlarged edition of the book reaffirming his 1798 reasoning and expanding the preventive check argument by emphasizing sexual restraint both within and outside the marriage state. Malthus ruled out the use of sex outside the marriage state as seriously immoral. Within the marriage state, Malthus ruled out all artificial means of birth prevention in these words (*8*) "Indeed, I should always particularly reprobate any artificial and unnatural modes of checking population, both on account of their immorality and their tendency to remove a necessary stimulus to industry." In this reasoning, Malthus was reaffirming 18 centuries of Christian teaching on the immorality of infanticide, abortion and unnatural modes of birth control (*10*).

The Malthusian arguments predestine mankind either to a life of subsistence or a life of immorality. Obviously, mankind is guaranteed neither economic plenty nor eternal salvation. Man's achievements depend upon his behavior in using his intellect and in exercising his free will. Man has the choice of living a good or an evil life. Likewise, man has the choice of economic plenty or poverty.

This conclusion draws support from history as well as from science and reason. The American colonies which provided empirical evidence for Malthus in developing his theory of population, today, as the United States of America, provide empirical evidence for refuting the theory. Such refutation has been succinctly stated by Dr. John M. Brewster (*2*), "The rate of gain of productivity of farm workers overtook the rate of population growth so that the age-old pressure of population upon food supply changed skins and became the pressure of food supply upon population." Other scientists have come to similar conclusions (*6*) (*13*).

Fallacies of Malthusian Reasoning

The first basic fallacy of Malthusian reasoning is a mistaken idea of resource productivity. The theory fails to comprehend man's intellectual powers of increasing resource productivity through research, technology and other labors of mind and body. Once a secret of nature's abundance is unlocked by a single mind, it can be shared by almost 3 billion people. This is how powerful the human mind can be.

Pursuing this fallacy further, natural resources cannot be defined in static terms of acres of land, barrels of oil or inches of rainfall. Natural resources are as expansible in productivity as is man's knowledge. Uranium was worthless until man discovered its use in atomic energy. We have exhausted our petroleum supplies 10 times since 1910 according to the best estimates over the years. However, today our proven supplies are greater than ever before. Improved technology for finding oil fields, deeper exploitation, secondary recovery, and conversion of oil shales account for this development.

The second basic fallacy in Malthusian reasoning is the mistaken notion of man's uncontrollable passions. Malthus despairs of man's abilities to control his appetites through reason and will. He compares men's behavior to plants and animals.[2]

Correcting Malthusian Fallacies

The future of the world's solution to population-resource problems lies not in reducing population to a static level of resource productivity. On the contrary, the solution lies in expanding man's knowledge of the use of resources and in applying this knowledge to make resources serve the expanding needs of growing populations. This country was overpopulated by Malthusian standards in 1492. Today it remains underdeveloped with 183 million people and will continue underdeveloped as long as man discovers and applies new knowledge to resources. If this be true of the United States, it is even more true of the rest of the world.

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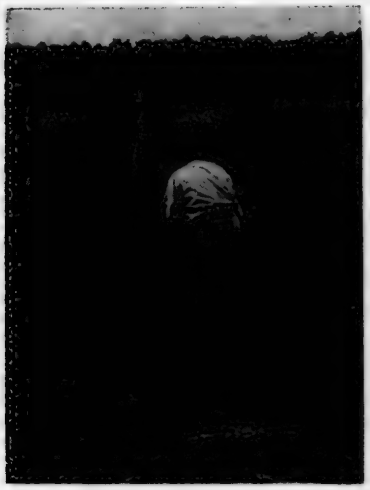
[1] Malthus (*7*) argued that population when unchecked, increases in a geometrical ratio, for example, 2, 4, 8, 16, 32, 64, etc. However, he argued that subsistence increases only in an arithmetical ratio, for example, 2, 3, 4, 5, 6, 7, etc. Thus, starting from 2 people and two units of subsistence, in five generations, there would be 64 people but only seven units of subsistence. Since 64 people could not be sustained by only seven units of subsistence, ". . . the effects of these two equal powers must be kept equal." In other words, population growth must be kept within the limits of his estimated supply of sustenance.

[2] Referring to animals and plants, Malthus said (*7*), "Necessity, that imperious all pervading law of nature, restrains them within the prescribed bounds. The race of plants, and the race of animals shriek under this great restrictive law. And the race of man cannot, by any efforts of reason, escape from it. Among plants and animals its effects are waste of seed, sickness and premature death. Among mankind, misery and vice. The former, misery, is an absolutely necessary consequence of it. Vice is a highly probable consequence, and we therefore, see it abundantly prevail; . . . ."



Man-hour requirements to produce 100 bushels of wheat in the United States dropped from 373 hours in 1800 to 11 hours in 1960. Introduced in America about 1776, the cradle was the common instrument of grain harvesting as late as 1840. Harvesting 2 acres with it was considered a good day's work. Cutting a 16 foot swath, the modern combine can easily harvest 120 acres in an 8-hour working day and operators have energy left at day's end for other pursuits. *International Harvester Photos*

Binay Ranjau Sen, presently Director General of the United Nations Food and Agricultural Organization,[3] states ". . . the central problem, as we see it, is not overpopulation, but overproduction. There are vast resources to be exploited. . . . Hunger is neither inevitable nor irremediable. It is within our power to bring this old affliction under control." Director Sen knows whereof he speaks since he was Director General of Food for all India during the 1942 famine in South Bengal. Even at that time, he declared there was sufficient food within the borders of India but widespread corruption and lack of means for distribution failed to prevent millions of people from starving to death.

The Woytinskys (*17*) in their monumental study, *World Population and Production,* conclude, "The technological progress initiated in the modern industrialized countries and now spreading to the remotest corners of the world is the answer to the carrying capacity of our planet, the depletion of its natural resources and the pressure of overpopulation. . . . No evidence has been found of a general tendency of mankind to outgrow available resources."

This means that the basic population-resource problems are underdevelopment of resources and not the overpopulation of humanity. The solutions are to be sought and found in bringing resource productivity up to and even beyond the material needs of humanity and not in dragging humanity down to a low and static level of resource use. Thus, man becomes the master, not the servant, of natural resources.

[3] Food and Agriculture Organization of the United Nations. 1960. *Announcement of world-wide five year war against world hunger.* FAO. Rome, Italy.

Population Growth and Soil Productivity in Process and in Prospect

Difference in world and United States population growth, soil productivity and implications for soil conservation suggest dividing this discussion into world and United States considerations.

World Population Growth

Today's world population may be characterized by three statements. World population, estimated at almost 3 billion, is greater than ever before. The estimated rate of growth, 1.6 percent per year, constitutes a record growth. The immediate future holds prospects for even greater rates of growth and total population. The word "estimates" is used advisedly, since the total world population has never been counted and remains merely an estimate which could vary as much as 10 percent. Nevertheless, available information emphasizes rapid growth of world population in process and in prospect.[4] Also, two-thirds of the world's people still live dangerously near the Malthusian level of subsistence.

[4] In the past, world population has never grown very fast for very long. Periods of population growth were followed by periods of war and disease which brought declines in population. Actually, man's numbers have expanded very slowly since his creation. Prior to the Christian Era, population increase was only about 0.005 percent annually. For the first 17 centuries after Christ, the growth rate was around 0.05 percent per year. However, during the nineteenth century, the rate jumped to 1 percent and the present rate is estimated at 1.6 percent per year.

If there had been only 24 persons on earth 100,000 years ago, the average annual growth to reach today's 3 billion people would have been only .02 percent per year. Today's rate of increase, estimated at 1.6 percent, is 80 times the rate of growth expressed under the above assumptions. If this 1.6 percent rate of growth had been in effect over the past 100,000 years, the 24 persons would have increased to a number containing 750 digits rather than the 10 digits in today's 3,000,000,000 population. In other words, add 740 zeros to today's 3,000,000,000 population to visualize what this assumption would yield.

USDA Photo

One of the major forces influencing soil conservation is world population growth. Though science and technology show that man has scarcely scratched the surface of the world's potential productivity, satisfying the needs of his growing numbers is a tremendous challenge.

If the 1.6 percent per year rate of population growth remains in effect indefinitely, the present 3 billion people would grow to 6 billion in 50 years, to 15 billion in 100 years, to 82 billion in 200 years and to 440 billion in 300 years.

However, the population scholars and experts in the United Nations are not so certain as to future population growth so they make three population projections for the world toward the year 2000 (*5*). These projections include a maximum of 6,900 million people, a minimum of 4,880 million people and a median of 6,280 million people.[5]

Experiences with population growth enable us to develop a general theory of the "demographic transition" as an aid in understanding population growth. This transition starts with high death and high birth rates and proceeds through various intermediate combinations of birth and death rates until low death rates are reached and birth rates adjust to economic conditions.

However, there are two important differences between the demographic transition as it evolved historically and as it applies today. First, mortality is declining more rapidly today in the high death rate countries than it did in Europe and North America a century ago. Second, the birth rate in the high death rate countries today is somewhat higher than was the case in Europe last century.

Europe has passed through the demographic transition with relatively low population increase; Latin America is in the middle stages of the demographic transition, having achieved a substantial decrease in deaths but with a birth rate that remains high. This combination gives Latin America a high rate of population increase and the rate of population increase there leads the world at the moment. Africa and Asia show relatively high birth and death rates, thus presenting the potential for substantial population increases as the death rate falls and the birth rate remains high.

People want to live and modern science makes longer lives possible. Consequently, birth rates appear particularly sensitive to population-resource interrelationships. Such sensitivity was experienced in Western Europe over the past two centuries until today there are only 19 births annually per 1,000 people. Both France and Ireland experienced greater than average decreases in births. A similar development took place in the United States during the past one-half century.

Resource Productivity as Related to World Population Growth

According to neo-Malthusian reasoning, rapid increases in population are plunging the world into starvation and annihilation. This position is not supported by facts. Measured in calories per person per day, the people of the world are increasing rather than decreasing their portions of daily bread.

From pre-World War II (usually 1938-39) to the present (usually 1958-59), the net food supply in calories per person per day changed from 2,520 to 2,580 in Italy, from 2,840 to 2,890 in the Netherlands, from 1,970 to 2,150 in Pakistan, from 2,050 to 2,100 in Japan, from 2,450 to 2,590 in the United Arab Republic and from 3,210 to 3,100 in the United States.

The world provides few if any examples of declining populations bringing forth wealth, prestige and culture. However, there are many examples of economic growth accompanying growing populations. Had England heeded Malthus and kept its population to the 1800 level, England would never have achieved its position of world leadership in the nineteenth century. France followed Malthus and declined continuously from its population peak around 1800. Had the Netherlands heeded Malthus, this courageous little nation would probably have passed into oblivion long ago. Instead, however, the Netherlands supports at one of the higher levels of living more people per square mile of area than any nation in the world.

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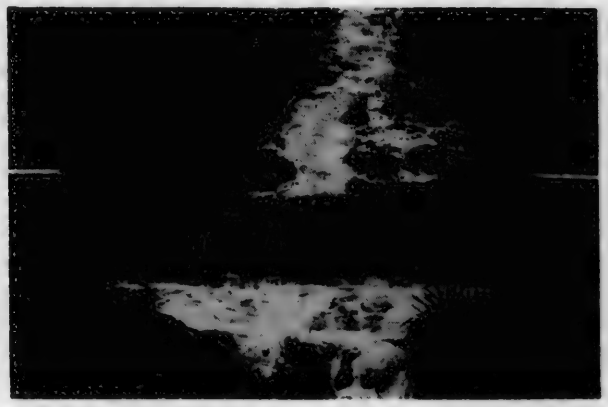
[5] The difference between the minimum and maximum projections is 2,020 million. This equals the entire population of the world as late as 1939. If projections of population growth by the world's population experts vary this much over only four decades, between 1960 and 2000, reliability of population estimates beyond the year 2000 remains very questionable.

Evidence of man's ability to increase resource productivity is demonstrtaed by the tremendous per acre corn yield increase achieved over the past quarter century in the United States. *Des Moines Register Photo*



Though this clear water flowing from agricultural lands indicates that effective measures for soil conservation have been applied, tremendous possibilities for conservation of water still exist. Water conservation measures must be more fully investigated and used, for one of the major foreseeable limitations to crop and livestock production in the United States is water. *SCS Photo by Merritt*

The United States has grown to 183 million people and the present high rate of population increase is a major factor bringing virility and growth to the economy.

Since World War II, West Germany has absorbed over 12 million refugees. However, rather than disintegrating under this staggering population increase, West Germany has experienced a tremendous economic upsurge. Today, less than two decades later, through the industry of its people, this nation has one of the lowest rates of unemployment and one of the highest rates of economic growth in Europe. Compared with East Germany under Soviet domination, West Germany stands out as a monument to a democratic government and an industrious people.

Severe limitations on population growth lead to stagnation, decline and even extinction. According to Malthusian and neo-Malthusian standards, France should have become the most affluent nation in Europe or the world. Following France's peak of world power, culture and prestige at the turn of the nineteenth century, divorce, onanism and family limitation became fashionable through the nation. The size of the French family declined—a trend which has persisted until recently. An aging population is not a virile one. Costs of pensions and the many services for aging people demand a heavy toll of taxes and income contribution by the relatively smaller working population.

Alternative Approaches to World Population and Soil Productivity Problems

Two major alternatives are open to humanity in providing material needs for the world's population in the near term—say the next four decades. During this period, United Nations population experts estimate world population may increase between 1,980 million and 4,000 million people so that the world population by the year 2000 would climb to somewhere between 4,880 and 6,900 billion people (*16*). Beyond the year 2000, estimates of population become so questionable that students of population, the demographers, prefer not to make guesses.

Either population growth is to be controlled downward to a relatively static level of resource productivity, or resources productivity is to be controlled upward to provide for the expanding population.

Alternative One

One alternative, the neo-Malthusian approach, considers population the dependent variable and resources the independent variable in the population resource equation. Under this alternative, population becomes the servant of the resource master through the Malthusian "positive" and "preventive" checks on population.

During the next four decades, an appreciable part of the population increase will come about through extending man's life span. Through increasing life expectancy at birth from the 35 years now prevailing in many less developed countries (an expectancy which prevailed in the United States a century ago) to the 70 years now prevailing in the United States and a few other countries, a doubling effect on population would take place. Thereafter, however, this source of population increase would depend upon medical science to extend the life expectancy at birth beyond three score and 10 years.

Alternative Two

Another alternative, the scientist's approach, considers resources the dependent variable and population the independent variable in the population-resource equation. Under this alternative, resource productivity becomes the servant and people the master. Actually, natural re-

sources are not fixed in their productivity nor are their productivities limited to increases of arithmetic progression as suggested by Malthus. Resource productivity is a function of man's knowledge and is limited only by his intellectual capacity and will to make resources serve the needs of mankind. Under this alternative, the major population-resource problems are underdevelopment of resources and not overpopulation.

Resources remain underdeveloped as long as innovations lag behind knowledge and knowledge continues to expand. This is as true for the United States as it is for India. In the United States, for example, agricultural output could be increased by one-third at least, with existing knowledge. At the same time, expanding knowledge makes further increases in productivity possible at the rate of from 2 to 3 percent each year.

Dr. Robert M. Salter (*14*) raises this question, "Is it, after all, reasonable to hope that the world can produce enough to feed all its human inhabitants? Can the world's soil grow all the crops that would be needed?" In answering this question, Salter replies, "I am convinced that we do have the soils we need, we do have the fertilizer reserves, we have available the management ability, and we could produce enough food for all."

As stated in *World Population and Production* (*17*), "The core of the problem of the carrying capacity of the earth is not the scarcity of fertile land in comparison with the number of mouths that must be fed but the insufficient ability of men to make full use of their available resources."

Let us proceed to suggest the major points in a program to provide for the world's rapidly increasing population. These include bringing new land into cultivation, increasing resource productivity through research to unlock nature's secrets, education and technical assistance to extend and apply the results of research, provision of capital to implement education, technical assistance, improving access to resources by people through emigration and trade, agrarian reforms to remove feudal blocks to progress, industrialization, and loans or direct grants and gifts of food and clothing with no strings attached.

The future challenge of ample food for the world's population is not beyond man's genius to meet successfully. We have the technological knowledge which the world's scientists are continually enlarging. Enormous potential food supplies remain largely untapped. There exist tremendous reservoirs of good will and human compassion throughout the world that are eager to help fellow men everywhere. More important, perhaps, we have an implement in the Food and Agriculture Organization made up of 79 member nations, dedicated to wage an unrelenting war against world hunger. On July 1, 1960, this organization launched a two-phase worldwide 5-year program. First, in every member country, a campaign committee is being established to solicit funds from governments, industry, private organizations and individuals. Second, a World Food Congress will be held in Rome in 1963 at which time implementing programs will be launched.

Finally, the question arises, what about standing room only? When confronted with the facts of ample food possibilities for all, neo-Malthusians sometimes resort to the "standing-room-only" argument. At current rates of population growth, the earth would be filled with people in about seven centuries so that each person would have only 4 by 4 feet of earth on the surface. However, long before this situation would arise, the birth rate would drop or knowledge will make interplanetary travel a reality, and Earth is an infinitesimal speck in the total universe.

In the meantime, humans probably have more important matters demanding their energies than worrying about "standing room only" seven centuries hence.

United States Population Growth and Soil Productivity

United States population currently is around 183 million. Deaths per 1,000 people per year have decreased progressively from about 17 in 1900 to around 9 currently. Coinciding with the Great Depression, births dropped to a low of 17 per 1,000 during the early thirties and climbed to a two-decade high of about 25 per thousand recently. Thus, offsetting the decline in deaths, and adjusting population to economic conditions, birth rates in the United States have varied significantly over the years.

This means that humans do not reproduce to their physical limits as Malthus implied, but instead, tend to adjust the number of births to their ability to raise and care for children. In the words of one writer (*12*), "Parents must foresee how they are going to fulfill their duty of bringing up their children. . . . The law of fertility demands that parents have that number of children they can both fittingly beget and fittingly educate. The law does not mean that parents must have as many children as possible. Parents must take into consideration their own health and resources, both physical, economical and spiritual; the well-being of their offspring, providing for them the best education possible; and they must also consider the wider implications and general good, both present and future, of the whole human race."

During the 1950's, United States population increased 17 percent while agricultural production increased 65 percent on a man-hour basis. Man-hour requirements to produce 100 bushels of wheat dropped from 373 in

1800 to 47 in 1940 to 11 in 1960. Requirements to produce 100 bushels of corn dropped from from 344 in 1800 to 83 in 1940 to 19 in 1960. Requirements to produce a bale of cotton dropped from 601 in 1800 to 191 in 1940 to 47 in 1960.

Between $20,000 and $25,000 of capital is required for each agricultural worker in this country as compared with only $17,000 for manufacturing industries. Today, aided by applications of knowledge and capital, each farm worker could support 25 other persons. During the early years of this Nation, 90 percent of the people were farmers.

Application of knowledge in the form of technology with the use of capital reduces the acres required to provide for a given population. In 1900, the United States used 4.2 crop acres per person. In 1950, this dropped to 2.6. Today, 2.2 acres of arable land per person are being used and farm product surpluses are piling up. Agricultural economists estimate between 45 and 75 million excess crop acres are devoted to farming.

Projections of United States population by 1975 range around 220-230 million people. Projections by 2000 range around 310-330 million (*3*). This means that by 1975, population in the United States would increase more than 35 percent above the 1955 level. Over a similar period, per capita real income may increase 40 to 60 percent. According to Ray Bressler (*1*), "With this increase in income and with a continuing shift away from cereals and to livestock products, it appears that the aggregate per capita consumption of farm products might increase 8 or 9 percent. Thus, domestic consumption of these products might rise by roughly 45 percent. Exports in the mid-1950's amounted to 10 to 12 percent of domestic consumption. If the absolute level of agricultural exports could be maintained, total utilization of farm products in 1975—at home and abroad—apparently would stand at some 40 percent above the 1955 levels. Requirements by commodities would range from roughly 10 percent increases for wheat, potatoes and beans to 50 percent or more for most of the livestock products, feed grains and fruits and vegetables."

Using results of the Daly (*4*) study corrected for estimated changes in production and population, the 1975 requirements would amount to an increase of only 20 percent over our current farm output. This represents an increase of 33 percent in livestock and 13 percent in crops.

Referring to the possibilities of continuing advances in technology, Dr. L. B. Nelson (*11*) concludes, "The truly major advances in the agricultural technology of the future are likely to result from new scientific breakthroughs, rather than from a slow accumulation of minor improvements. . . . That additional major discoveries will be made and at an accelerated rate, seems without question. Science is the new frontier which we have hardly started to exploit."

Potentials for increasing agricultural production in the major production regions of the United States indicate that by 1975, crop land requirements may shrink to 300 to 325 million acres compared with the current 400 million acres counted as cropland. Furthermore, the production of major crops, corn, wheat and cotton, may be expected to become more concentrated on fewer acres in core areas which enjoy comparative advantages of specialization (*15*).

Our major foreseeable limitation in crop and livestock production in the United States over the next 25 to 40 years is water. With the national consumption of water increasing about 5 percent annually, shortages of water for agriculture are likely to become increasingly severe. "The only alternative to moisture shortages is moisture conservation. Fortunately, there are tremendous possibilities for moisture conservation which fall into three main categories: Conserving runoff water for irrigation, getting more water into the soil moisture reservoir, and obtaining more efficient utilization of the available moisture stored in the soil" (*12*).

REFERENCES CITED

1. Bressler, R. G. 1961. *Land use patterns towards which adjustments may be directed.* In *Dynamics of land use: needed adjustments.* Iowa State University Press, Ames, Ia.
2. Brewster, John M., 1945. *Farm technological advances and total population growth.* J. Farm Econ. 27 (3) p. 509.
3. Clawson, Marion, R. Burnell Held and Charles H. Stoddard. 1960. *Land for the future.* Johns Hopkins Press, Baltimore.
4. Daly, Rex F. 1956. *The long-run demand for farm products.* Agr. Econ. Research 8(3) July.
5. Food and Agriculture Organization of the United Nations. 1958. *Production yearbook.* Vol. 12. FAO, Rome, Italy.
6. Kellogg, Charles E. 1948. *Modern soil science.* Am. Scientist 36(4) Autumn.
7. Malthus, Thomas Robert. 1798. *An essay on the principle of population as it affects the future improvement of society.* 1st. ed. Oxford University Press, New York, N. Y. p. 13-15.
8. Ibid. 1817. 5th ed. p. 13.
9. Minnesota Agricultural Experiment Station. 1959. *Policies for expanding the demand for farm food products in the United States.* Tech. Bul. 231. Minn. Agr. Exp. Sta., St. Paul.
10. Myrdal, Alva, and Paul Vincent. *Are there too many people?* Food and People Series No. 5. United Nations Educational, Scientific and Cultural Organization. New York, N. Y.
11. Nelson, L. B. 1961. *Physical potentials for crop production.* In *Dynamics of land use: needed adjustments.* Iowa State University Press, Ames, Ia.
12. Nevett, Albert. 1959. *The population dilemna.* Samuel Walker Ltd., London, England. pp. 32-33.
13. President's Materials Policy Commission. 1952. *Resources for freedom report, Vol. 1.* U.S. Government Printing Office, Washington 25, D.C.
14. Salter, Robert M. 1947. *World soil and fertilizer resources in relation to food needs.* Science 105(2734) May.
15. Shrader, W. D. and F. F. Reicken. 1961. *Potentials for increasing production in the corn belt,* Chap. 5. R. W. Pearson, *Cotton production trends,* Chap. 7. Andrew R. Aandahl, *Potentials for increasing wheat production in the Great Plains,* Chap. 6. In *Dynamics of land use: needed adjustments.* Iowa State University Press, Ames, Ia.
16. United Nations. 1958. *The future growth of world population.* United Nations, New York, N. Y.
17. Woytinsky, W. S. and E. S. Woytinsky. 1953. *World population and production.* The Twentieth Century Fund, New York, N. Y. p. xii, p. 324.

Utilizing the Natural Resources of the Sea

LOUIS S. KORNICKER

World conferences dealing with population growth and food supplies have repeatedly emphasized that great weight should be given to increasing the production of protein food from the sea. Many food economists look to the sea to provide the large quantities of food necessary to supply the world's needs in the future. If the living and mineral resources of the oceans are to be utilized effectively, a more intensive program of fundamental and applied research must be initiated.

WHAT IS BEING DONE to insure that future populations will harvest from the sea the vast quantities of food that will be required? The many state and national conservation agencies and international commissions may be adequately regulating established fisheries, but these fisheries are not likely to supply more than a small part of the additional seafood requirements of a rapidly expanding population. Conservatory measures and regulating agencies are usually established after current fishing efforts have materially decreased yields. Though regulatory agencies in many instances have been able to raise the yield back to the level existing prior to the period of overfishing, and occasionally a somewhat higher yield has been obtained, one must, however, look elsewhere if the current annual 33 million ton harvest of seafood is to be doubled or tripled.

Natural-resource programming in the sea, which has more or less been restricted to the regulating of established fisheries, should be expanded to include development of new and unexploited resources. In some instances, potential resources are known, but for one reason or another have not been developed. For example, only 2 percent of the world's seafood production comes from the southern hemisphere, although the fisheries potential there is probably as great as that of the northern hemisphere. If commercial development of the fisheries is not feasible at present, adequate studies should be carried out so that when world food requirements make exploitation of southern hemisphere fisheries mandatory, it will be possible to develop them rapidly and efficiently.

Increasing Fish Yields

Just as certain geographic areas have been fished more intensively than others, certain water depths have been fished more intensively than others. Commercial fishing has generally been confined to the water surface or the sea bottom. Recent trials, using a mid-water trawl, indicate that fish in sufficient quantities to support commercial fisheries live at water levels between surface and bottom. Fish life at mid-water levels certainly warrants more intensive study than it has received.

Another area that warrants accelerated study is the fisheries potential of the deep oceans. Early fisheries were developed close to the home base where water was sufficiently shallow to manipulate nets and lines by hand or with simple mechanical help. Recent fishing trials carried on in water deeper than the usual commercial fishing depths revealed a sufficient number of large Tuna in one area to suggest that the deep ocean may have potential as a food source.

The food potential of the major ocean currents, especially the newly discovered currents moving below and in opposite direction to the long-known surface currents, demands more intensive investigation. These currents may serve as travel lanes for migratory fish and prove to be of considerable importance to the development of fisheries for migratory species.

In addition to development of fisheries in their natural environment, it is entirely probable that in the future man will be able to exert greater control over fish. There is some indication that fish will eventually be in the same category, production-wise, as are cows, chickens, bees and the many other animals raised by man.

Fresh water fish are raised today for commercial use in ponds under controlled conditions; it takes no great leap of the imagination to conceive of a fenced-in marine lagoon or bay in which salt-water fish are raised.

Salmon spend their youth in a fresh water stream and then travel to the sea. As adults they return to the same stream at spawning time. This behavior of the salmon is used to advantage by stocking streams with fingerlings and then catching the adults when they return from the sea. Eventually it may be possible to use this technique on other species.

Some work has been done in creating artificial environments for fish. The Red Snapper is a commercially important fish that concentrates around reefs and rock ledges. A large number of old automobile bodies have

Louis S. Kornicker is a geologist with the Office of Naval Research, Department of the Navy, and is headquartered at Chicago, Illinois. Views expressed in this article are those of the author and not necessarily those of the United States Navy.

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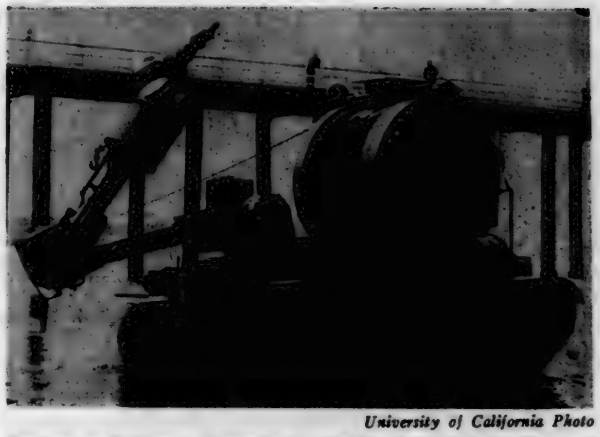
been dumped into the sea in the Gulf of Mexico, off the Texas coast, and in other areas, in order to attract the Red Snapper.

These are but a few examples of instances where man has been able to exert greater control over fishing through knowledge of fish behavior. As more is learned about what takes place in the sea by means of both basic and applied scientific investigations, man will come ever-closer to intelligent control over the fishes. Ultimately, it should be possible to upbreed fish stocks in order to improve the yield or nutrient content.

A simple way by which existing fishery yields could be increased is by greater use of the so-called "trash" fish. These are fish that have little commercial value and are often discarded when they show up in a fisherman's net. Trash fish are being used increasingly in animal feeds and fertilizers, but many species would assume commercial importance as human food if people would accept them. With a tightening food supply individuals will perhaps have to be less selective.



University of California Photo

Remote underwater manipulator vehicle of the Marine Physical Laboratory, Scripps Institution of Oceanography, is designed to crawl about the ocean floor in depths divers cannot penetrate. The powerful manipulator, an electro-mechanical device which simulates the motions of the human arm, is a modified version of one used in atomic laboratories. Five miles of cable are carried on the drum, and four television cameras are mounted on the vehicle. Though still in the experimental stages, a machine of this type will be most useful for scientific investigations and could be adapted for mining the sea.

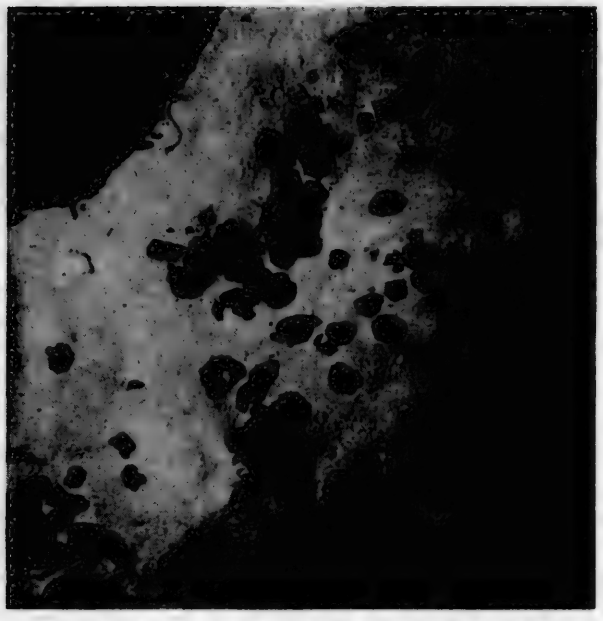
Mollusks and Crustaceans

About 16 percent of the total sea food production comes from mollusks and crustaceans. At present, it appears doubtful that yields from the harvests of these animals can be materially increased. Oysters flourish within very narrow environmental boundaries. They form reefs in shallow water close to land where the salinity is sufficiently low to discourage oyster predators, such as starfish and carnivorous snails. The closeness to land makes oyster reefs quite vulnerable to destruction by over harvesting and various factors that follow industrialization, such as dredged channels, oil spills from ships, and general pollution. Natural reefs near populated areas are dwindling, but yields are being maintained in part by oyster farming. It seems likely that as the coastlines become more populated and industrialized, the areas suitable for oyster farming will decrease, until eventually they will survive only in specially designated areas and will not be harvested in sufficient quantity to be a major food source. Unless greater effort is made to maintain bays in a natural condition, the pressure of increasing population and industry will eventually lead to the destruction of all except the more hardy forms of animal and plant life. In the southern hemisphere, oysters are not being harvested to capacity; it should be possible to maintain current world yields for many years by developing these oyster beds.

Clams are in somewhat the same position as oysters. However, they are less vulnerable in that some edible varieties flourish in the deeper offshore waters. Even these varieties could be easily wiped out with modern dredging techniques which suck clams off the bottom like a vacuum cleaner removing dust from a rug.

The harvest of mollusks could be easily increased. Many species of clams and snails that could be commercially important are not eaten; other species are eaten in some parts of the world but are not popular elsewhere. The mussel, for example, is extremely popular in Europe, but is seldom eaten in the United States. Another example of a mollusk popular in one area and not in others is the squid. The Japan squid fishery catches about 600,000 tons of squid annually, but they are eaten exclusively only in southern Europe and in the Orient. The possibility of developing squid fisheries in other areas of the world should be investigated.

Most commercial species of shrimp spend part of their life in shallow bays and lagoons; therefore they are vulnerable to destruction if the bays should become uninhabitable. The shrimp spend the early part of their life in shallow water and then migrate to deeper water where they grow to maturity and reproduce. There has been some success in fencing-in shallow areas containing young shrimp and then harvesting them after they mature. Unfortunately they do not reproduce in the shallow water area, thus it is necessary to restock the fenced-in area annually. Several laboratories have been successful in the artificial propagation of shrimp in aquaria, and it is possible that continuous shrimp farming will be a reality in the future. Farming of shrimp does not seem to have the attention it deserves. The initial successes in artificial propagation in the laboratory should be followed up with a full scale attack on the problem. The high protein content of shrimp and the rapidity with which it reaches maturity and reproduces make it an ideal animal for cultivation.



Manganese nodules on the ocean floor in the Southwest Pacific Basin. Depth is 4560 meters, field coverage is approximately two-thirds square meter. *U.S. Navy Photo by Skipek*

Primary Elements in the Food Chain

A source of food that has been suggested many times, especially during wars when food shortages exist, is plankton. Plankton is composed of microscopic animals, called zooplankton, and microscopic plants, called phytoplankton. The zooplankton consist of small crustaceans, fish eggs, and the larvae of many animals. Phytoplankton consist almost completely of microscopic algae.

It is strange that although plankton has a tremendous potential as a source of food there is very little applied research being carried out to develop it for that purpose. There is, however, a considerable amount of basic scientific data being accumulated on plankton distribution. This information will be of great practical value if plankton eventually is used for food. In view of the fact that the amount of plankton in the ocean is far greater in quantity than all larger animals or plants, man should proceed at full speed in developing this natural resource as a food. An argument used against developing plankton as a direct source of food is that it may be more economical to capture plankton-eating fish than to collect plankton. This argument may be valid, but man can ill afford not to make every effort to exploit the food chain at the lowest possible level.

In recent years, there has been considerable interest in the possibility of using fresh-water planktonic algae as both a source of food and oxygen in space ships and submarines. Laboratory equipment has been designed in which a culture of algae is maintained and from which the excess algae are periodically removed. These units are small, but they could be constructed on a larger scale to supply large quantities of food. Although fresh water algae have been used in experiments, salt-water varieties could probably be substituted.

A discussion of potential foods from the sea would not be complete without the mention of sea weed, which is mostly macroscopic algae. Some sea weeds are used extensively for food in the Orient where they have been cultivated for many centuries. As they are low in protein, the major food value is in their mineral and vitamin content. Those who do not relish the idea of eating sea weed should remember that over half the ice cream made contains the chemical algin, which is derived from sea weed and is used in ice cream to provide smoothness of texture and body. In the United States, sea weed is extensively used as a source of unusual chemicals and in cattle and poultry feeds. There is much room for experiment in cultivating sea weed and also in investigating the properties of chemicals derived from algae. To date only a small number of species has been thoroughly studied.

Other Resources

In addition to the living resources available in the sea, the sea and the sea floor are rich in mineral resources. Oil, coal, and iron are presently being removed from the continental shelf. The continental shelf also contains deposits of sulphur and phosphates, and the deep sea floor contains manganese deposits of potential importance.

The water of the sea is thought to contain at least a trace of every chemical element. Yet, today only common salt, magnesium and bromine are removed from sea water on a commercial basis. Because present availability of other elements on land makes their removal from sea water uneconomical, very little work is being done to develop processes for the removal of specific elements.

The sea is also a potential source of fresh water. Tremendous strides have been made in the last few years in designing equipment for deriving fresh water from the sea and eventually fresh water may be the sea's most valuable resource.

Summary

The yields from established fisheries are apparently being successfully sustained through regulatory measures. A decrease in yield is predicted for those animals that spend part of their life cycle in brackish bays unless greater effort is made to prevent destruction of their habitat by population and industrial pressures.

Programming must be expanded to include the development of new and previously unexploited resources if the sea it to have a significant role in supplying the food requirements of a rapidly growing world population.

Another Look At River Basin Planning

KENNETH C. NOBE

The Report of the Senate Select Committee on National Water Resources has focused nationwide attention on the growing need for multiple-purpose use of the nation's water resources and recommends immediate planning of systems for optimum development of the water resources of all the major river basins in the country. This article describes the approach to comprehensive, systematic river basin planning employed in the Potomac River Basin Survey.

SENATOR KERR, Chairman of the Select Committee on National Water Resources, states in the Foreword of the Committee Report:[1] "Formulation of a program to meet the Nation's needs must await the preparation of detailed and comprehensive plans for water resources development in each of the river basins. The select committee recommends that such plans be developed cooperatively by the appropriate Federal and State agencies at the earliest practicable time."

The need for immediate river basin planning has been established. An understanding of the tools and methodology for formulating development plans becomes a prime prerequisite for getting the job done.

Planning for comprehensive river basin development is a team effort. It requires the coordinated assistance of many disciplines and agencies at various levels of government—local, State and Federal. Requirements for cooperation in all aspects of coordinated water resource development within a river basin must continue from the very beginning of program formulation. In the Potomac River Basin Survey, which will be discussed as a case study in this paper, stress has been placed on this coordination of activities.

Objectives of River Basin Development Projects

A common objective of water development projects is to satisfy anticipated additional demands for water by changing the amount, quality, time, and place of water use. Project formulation assigns the available supply of water among potential uses having different values, but not necessarily on the basis of value alone; laws and institutions also affect allocation. The major purposes of project development are most often to insure adequate quantities of water of suitable quality for irrigation and municipalities and for hydroelectric power, but other requirements including flood control, recreation, and esthetic values should also be given full consideration to insure that no elements of an optimum plan are overlooked. It should be clearly understood that if even one potential use of water is not taken into consideration during the planning stage, by definition, a comprehensive development plan cannot be obtained.

Planning for optimum development of a river basin cannot be accomplished by limiting the study solely to the water resource. If land be defined as the surface, subsurface, and suprasurface of the earth, water becomes a part of the land complex. The interrelationships of soil and water in this complex often make it difficult, if not impossible, to completely isolate either component for independent analysis or investigation. In formulating a project for development of the water resource, therefore, the land component in its entirety must be taken into account.

A combination of engineering, economic, ecological, and social principles is needed to select the most efficient combination of alternative, competitive, and complementary uses, and to take advantage of the economy and greater utilization of resources made possible by multipurpose development. The proper balance of purposes should be selected by combined appraisals of the extent of the resources available, comparative needs for various uses, applicable laws, policies and public support. Both present and future needs are taken into account. This involves an economic evaluation of alternative uses that may include, in any given project, such competitive uses as irrigation, dry farming, grazing, forestry, mining,

Dr. Nobe is the project economist for the Colorado River Basin Water Quality Control Project of the U. S. Public Health Service, with headquarters at the Denver Federal Center, Denver, Colorado. He was formerly the Agricultural Research Service representative on the Potomac River Basin Survey Field Committee in Washington, D. C. and continues as a consultant to the Corps of Engineers, U. S. Army, for the Potomac River Basin Project. *Special recognition for ideas and suggestions embodied in this paper are tendered to Harry E. Schwarz, Potomac Project leader, Corps of Engineers; Alvin C. Watson, river basin representative, U. S. Department of Agriculture; Norman R. Tripp, Forest Service representative, Potomac Field Advisory Committee; and Melvin E. Scheidt, program advisor, U. S. Public Health Service.*

[1] Senate Select Committee on National Water Resources. January 1961. *Report No. 29.* 87th Congress, 1st session. Washington, D. C.

wildlife, recreation, highways, and urban and industrial development. To satisfy the objective of planning for optimum development, a truly comprehensive analysis of the situation is required.

Basic Steps in River Basin Planning

River basin planning can be subdivided into three major steps for discussion purposes: (1) Determining present and future needs; (2) evaluating the possibilities of meeting these needs; and (3) selection of those measures which will meet anticipated needs at the least cost. The planning process, though it can be stated in simple and direct terms, in practice becomes a complex and exhausting effort. Before discussing how these steps were carried out in the Potomac River Basin Survey, it appears desirable to dwell briefly on the theoretical framework of project formulation so that the modifications of this approach as used in practice can be more easily understood.

Project formulation or river basin planning is deeply rooted in the basic concepts of welfare economics.[2] It is concerned in particular with the concepts of resource allocation in response to consumer preference, measured by placing relative weights or importance on alternative uses for a given resource. This implies that increased welfare results when the use with the highest marginal productivity is selected. In this context, project formulation is the process of selecting and evaluating the purposes to be served, the physical means of development, the size of the facilities and the area to be benefited so as to maximize net returns and human satisfactions derived from the economic resources used in the project.

Project formulation consists of weighing the effects of alternative proposals. The physical effects of each separable segment are translated into benefits for comparison with its corresponding costs.[3] A specific proposal is analyzed initially. This is usually a nucleus of development that, on the basis of the data available, appears most likely to meet the objective of the project. Next, consideration is given to scales of development greater or less than the selected nucleus depending on the "goodness of fit" of the initial proposal. The incremental analysis is continued by adding, or in some instances subtracting, major segments of size, purpose, or type of structure, and evaluating the resulting increments of benefits and costs. Cost of such segments should be tested by comparison with benefits from alternative sources. The incremental analysis is a series of comparisons of benefits with and without the inclusion of particular segments. An economically desirable plan with the maximum excess of benefits over costs will be approximated by treating the segments in descending order of their benefit-cost ratios, until the last increment adds benefits only equal to the cost of its inclusion.

A Case Study

The range of alternatives that are evaluated in water resource development projects is limited by the information, time and funds available. In order to insure the broadest possible consideration at all levels of responsibility an underlying principle of river basin planning should be close cooperation and free exchange of information among the Federal, State, and local groups involved. This has been the case in the Potomac River Basin Survey, which appears to be one of the more advanced efforts to date of systematic river basin planning.

Physiographically the Potomac drainage basin resembles a well-worn tomahawk with a broken handle. It encompasses a drainage area of 16,670 square miles. The Potomac River rises in the highlands of the Allegheny Plateau and flows for 383 miles to the Chesapeake Bay. The upper reaches of the main stem and its tributaries flow primarily through rural areas. The 122-mile lower stretch of the river is a broad tidal estuary which links Metropolitan Washington with the sea. About 3 million people presently live in the Potomac service area, almost two-thirds of them in the Washington metropolitan area. An estimated 7.3 million persons will live in the Basin in 2010 with over 70 percent in the expanded Washington metropolitan area.

The Corps of Engineers is engaged in a study of the water resources of the Potomac River Basin under Congressional authority which directs: ". . . preparation of a plan for flood control, recreation, and development and conservation of municipal and industrial water supply and pollution abatement." The primary objective of the survey is to devise a plan that will provide maximum net benefits from water resource development and will present specific recommended measures to be undertaken before the year 1985 and those to be undertaken before the year 2010.

The determination of overall water needs and an analysis of alternative means of development and control require a detailed appraisal of expected future municipal, industrial, agricultural and recreational developments in the basin. In this regard the authority directs: "To insure broad and adequate coverage of these subjects, the Corps of Engineers shall coordinate fully with the Interstate Commission on the Potomac River Basin, and with the States of Maryland, Virginia, West Vir-

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[2] For a detailed discussion of this concept refer to: Allen V. Kneese, December 1959. *Water Resources—Development and Use*, Technical Appendix, "Benefit-Cost Implications of Welfare Economics." Federal Reserve Bank of Kansas City. pp. 59-63.

[3] For a discussion of the procedure suggested to Federal agencies refer to: Subcommittee on Evaluation Standards, Interagency Committee on Water Resources. May 1958. *Proposed Practices for Economic Analysis of River Basin Projects*. Washington, D. C.

Photo by Interstate Commission on Potomac River Basin

The Potomac River, draining an area of 16,670 square miles, flows sluggishly through Washington, D.C., on its way to Chesapeake Bay.

ginia, Pennsylvania and the District of Columbia, and the National Capital Regional Planning Council and other Federal agencies concerned, to insure full consideration of all views and requirements."

The study began in 1956 and is scheduled for completion in June 1962. A preliminary progress report, submitted to Congressional committees in February 1960, outlined some of the possible alternatives for the ultimate development plan.

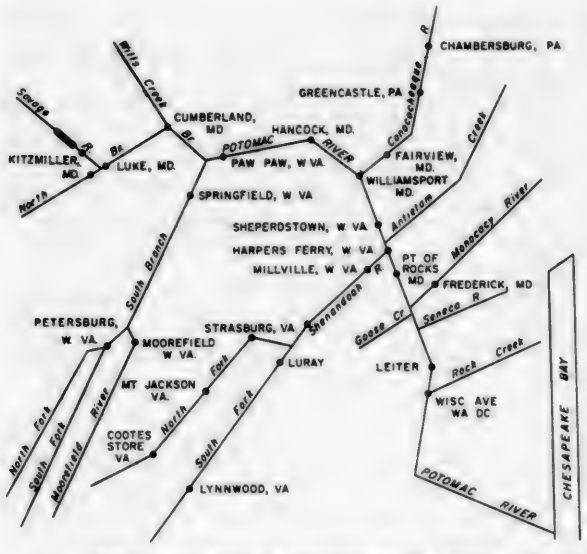
The study is being developed in accordance with the three steps in river basin planning mentioned earlier. In practice, the determination of requirements and an inventory-evaluation of resources available for meeting those requirements were carried out concurrently. Step 3, formulation of the development plan, is still underway.

Ideally, project formulation for water resource development proceeds in an additive manner downstream from the sources of streams to their mouths. Measurement of waterflow will serve as an example. Below the point of intersection of two streams, A and B, their combined flows are additive. Likewise, flows from tributaries entering the combined flow downstream from the point of intersection are added to the total flow. Withdrawals are subtracted from the total flow along the stream as they occur. The development of the Potomac project formulation, based on the basic supply and demand data assembled in the first two phases of the study, is likewise proceeding in an additive manner downstream from the headwaters of the basin to its outlet into Chesapeake Bay.

Oultined briefly, the three-step procedure used in the Potomac River Basin Survey included:

Determination of Needs

Many fields of scientific endeavor were employed and coordinated with projections of future conditions to provide overall estimates of future water needs. Water needs are primarily a function of population and its economic activity so initial efforts were directed at obtaining estimates of population numbers and associated economic activity for the present, 1985, and 2010. The Office of Business Economics of the Department of Commerce prepared an estimate of overall present and future population and economic development in the basin. The Department of Agriculture collaborated in estimating the percentage of the overall population and economic growth that would occur in the rural sectors of the basin. Based upon these estimates of population and economic growth, the Public Health Service made a determination of urban, domestic and industrial water requirements. The Department of Agriculture estimated rural water requirements for domestic, irrigation, livestock and



Schematic diagram of Potomac River drainage system.

other miscellaneous uses. Requirements for fish and wildlife were provided by the Fish and Wildlife Service and an inventory of water-oriented recreation requirements was provided by the National Park Service. Estimates of requirements for industrial uses outside municipal supply areas were assembled from available data from many sources.

Recognizing that water for these combined requirements will be reused many times as it flows downstream, consideration was given also to quality conditions. The Public Health Service, on the basis of recommended standards of the Interstate Commission on the Potomac River Basin, set levels for waste treatment and dissolved oxygen that vary by individual stream reaches. In the areas upstream from the Washington metropolitan area, for example, waste treatment removal levels of 80 percent in 1985 and 85 percent in 2010, and a dissolved oxygen level of 5 parts per million, were assumed. In the estuary portion of the stream below Washington, D. C., waste treatment removal levels ranging from 80 percent to 90 percent in both 1985 and 2010 were assumed. A desired dissolved oxygen level of 4 parts per million was indicated for this portion of the river system. Low flow augmentation requirements to insure desired quality conditions were subsequently developed on the basis of these assumptions.

In order to provide a common denominator for these diverse needs a standard unit of measurement, expressed in million gallons of water per day, was adopted. The combined requirements expressed in peak demand days and identified in cubic feet per second flow required, were recorded on a schematic diagram of the river system. A point source system was used; namely at given points, usually where a concentrated need was apparent, a cubic feet per second requirement total was recorded.

Flood protection is one major aspect of water project formulation that does not lend itself directly to daily flow supply and demand analysis. Rather, it is evaluated from the standpoint of how much flow would have to be withheld at specific points during periods of high flow to effectively reduce the flood crests to acceptable levels. These levels were determined jointly by personnel from the Corps of Engineers and the Department of Agriculture, taking into account possible loss of human life, and the probable economic effects of given levels of control. Again a point source system was used to identify towns, cities, and flood plains in agricultural and industrial use where some specified reduction in flood levels would be economically justified.

Inventory and Examination of Resources Available

Determination of the ability of the river system to meet the expected needs began with a careful examination of daily and annual flow records. An analysis of yearly flow totals quickly indicated that there is enough water flowing in the basin on an annual basis to meet all requirements. Extreme shortages were indicated, however, at many points in the basin during droughts and their associated low flow aftermaths. These minimum low flow data were also recorded in cubic feet per second figures at the corresponding demand points on the schematic diagram of the river system. All shortages were separately indicated.

Because it was found that low flows were insufficient to meet anticipated future needs, alternative measures to increase the water supply were considered. These included: Diversion of water from adjacent streams, pumping from ground water supplies, release from upstream reservoirs of waters stored during periods of excess flow, desalting of brackish water, reclamation of waste water, land treatment measures to reduce transpiration and runoff, and rainfall stimulation.

These studies indicated that a combination of land treatment and reservoir storage provided the only economically feasible approach to providing for requirements over and above normal low flow. It was found for example that the desalination of sea water was far too costly at present and its application would be limited primarily to the downstream portions of the basin. Tapping of ground water was ruled out because of generally limited supplies, as reported by the United States Geological Survey.

An inventory of large dam sites by the Corps of Engineers indicated that some 23 sites appeared to be economically feasible of development. These are back-

stopped, according to results of a Department of Agriculture study, by approximately 2,500 small and intermediate upstream sites.

Project Formulation

By late fall, 1960, most of the necessary data—demands, natural flow volumes, potential reservoir additions to flow, flood reduction requirements, economic cost and benefit evaluations, and the like—had been assembled and the final phase of the Potomac Survey got underway. The task at hand was to develop several combinations of large, medium and small reservoirs which would provide the water required for rural and municipal uses, low flow supplementation, flood protection, and recreation at given units of costs. It is intended that the report, when completed, will present not only the plan which appears most satisfactory from the standpoint of overall benefits, costs and impact on people, but will develop also a series of alternate proposals. These alternative proposals are being designed to take into account various points of view that result from conflicting social values among the numerous groups of people that will be affected by this river basin development. These alternatives are to be included so that after full public discussions of these plans, Congress can make a choice of solutions based on a complete knowledge of the problems and ramifications.

The selected approach to project formulation appeared deceptively simple. A plan would be developed, with alternatives, which would provide reservoirs to serve local needs, consistent with economic returns, and the excess storage, combined with inflows, would be funneled downstream for reuse. Those sites which appeared most feasible and economically desirable would be selected to satisfy each area need. Planning work would start in the remote upstream watersheds and proceed downstream.

It would be worthwhile to point out here that the approach to project formulation was developed essentially in accordance with the principles of accounting. In other words, we would construct a water budget. Our water need figures included two factors. The first was the amount of withdrawal, measured in cubic feet per second flow, needed to satisfy rural and urban domestic needs, industrial processes, rural livestock and irrigation, and other consumptive requirements. The second component in our budget was the amount of water which would be needed to provide sufficient flow to assimilate treated waste from communities and maintain the stream at acceptable quality standards for fish and wildlife, recreation, and reuse downstream. Careful note was taken of the amount of return flow from previous uses that would contribute to this latter requirement.

Photo by Interstate Commission on Potomac River Basin

Bass fishing in the clear waters of the North Fork, a tributary of the Potomac in Pendleton County, Virginia.

We would proceed in line with the concept that any quantity of flow added to the stream at any point will continue to flow down the river in substantially undiminished volume to serve downstream needs. Our job would consist of keeping track of the debits and credits involved in our water budget as we worked downstream, and of course, to record the amounts of benefits and costs associated with them. Upon satisfying the immediate needs in the headwater areas, consisting for example of rural domestic, on-farm and small town water supply needs, flood protection, and recreation from a proposed reservoir supply, we would trace the residual flow downward to the point of next demand. If sufficient flows were indicated at the next demand point, we would continue on downstream without providing for additional flow supplementation from reservoir storage. Should an additional amount be required, however, the analysis was to be stopped and a reexamination of potential supply increases upstream made. The measure selected would be either an increase in capacity of an existing upstream reservoir, or by the addition of another, de-

National Park Service Photo by Rowe

Use of resources for recreation is an important part of wise natural resource planning and development. The President's Cup Regatta on the Potomac River at Washington, D.C. is an example of the numerous water-based recreational activities Americans pursue during their increasing leisure time.

pending upon which could meet the need at the least cost. With the addition of this extra supply, the analysis of the new flow as it moved downstream would be continued until another deficit point was reached. At that point the reexamination of supply increasing possibilities would be carried out. The same procedure would be followed downward to the ultimate downstream point of water demand.

When the actual project formulation phase was begun, a number of additional factors were taken into account. First, it was readily apparent that a high proportion of total requirements were centered far downstream in the Washington metropolitan area. Second, this water would have to be stored at some distance upstream where the most suitable sites were located. Third, because of the huge amounts of water needed in the Washington area, almost all of this requirement would have to be met from the larger reservoirs under consideration for the small and intermediate ones could not begin to cope with this part of the anticipated requirements. Fourth, large portions of the basin lie upstream of the sites of the larger reservoirs under consideration and the needs of these areas could be most economically met from reservoirs located in the upstream headwater areas.

A plan of approach was adopted whereby in the initial phases of project formulation, the Department of Agriculture would carry out the required analysis for those areas upstream of the larger structures. The Corps of Engineers would concentrate on analysis of those larger structures needed to meet anticipated Metropolitan Washington and other demands downstream.

Upon completion of the formulation of the system above the Corp's proposed sites, this upstream portion of the system will be integrated with the large-dam analysis and carried on downstream until the last demand source is satisfied to the extent that the benefits will exceed costs. This will be accomplished on the basis of an overall benefit-cost analysis of all potential structures included in the recommended plan and its major alternatives. It is during this phase of the survey that the necessary sequence of timing is taken into consideration.

A final step in the project formulation phase involves an impact analysis of the recommended system and its alternates. After these systems are initially developed, based primarily on engineering feasibilities and economics, consideration will be given to the social, political and economic consequences in the impact areas of the proposed reservoirs included in the various systems under consideration. The final choice of a recommended system and the most likely alternate plans will evolve from a thorough study of these additional considerations. This could conceivably result in the selection of alternatives which will involve increased costs, but which would result in the addition of large increments of intangible benefits. The Potomac River Basin Survey can only recommend a choice of solutions; the final decision will rest in the hands of the public, acting through their duly elected representatives in Congress.

Conclusions

The foregoing discussion obviously represents some aspects of the ideal in planning for river basin development. One should not lose sight of the fact that actual experience on previous studies and those now in progress provided ample evidence that the ideal has not yet been attained. Perhaps it will never be attained. Successive studies, however, are profiting from the experience gained in the previous ones. In time, perhaps not too far in the future, comprehensive river basin planning will become a reasonably well-organized science.

Effects of Windbreak Plantings on Adjacent Crops

B. W. GREB AND A. L. BLACK

Field windbreaks and farm shelterbelts are multi-purpose assets to Great Plains agriculture. Though advantages outweigh the disadvantages, windbreak plantings in northeastern Colorado do depress growth and yield of adjacent annual crops. They apparently have little effect on native and introduced grasses. However, competitive effects on adjacent crops vary with age and species of the windbreak planting.

SOVIET INVESTIGATORS Bolyshev and Solov'yev (*2*) describe the value of shelter belts on virgin land as follows:

> "In arid steppe regions one of the most important conditions for producing steady crops is the presence of shelterbelts. This is shown by data accumulated over a period of many years by scientific research institutes and the abundant experience of state and collective farms both in Kazakhstan and in other regions having climate and soil conditions similar to those of Kazakhstan.
>
> "Shelterbelts improve the moisture relations of the air and the soil and protect the fields from hot, dry winds, from having the seedings blown away and from drifting of the land during the violent dust storms usual in Kazakhstan."

Chernikev (*3*) concluded that soil within shelterbelts in the Yergeni plateau had higher temperatures in winter and lower ones in the summer. Temperatures were reduced as much as 20°C. in the upper half meter of soil while soil parent material temperatures were decreased 1-4°C. within shelterbelt areas. Soil moisture relations, however, were only slightly improved.

Observations in the central Great Plains indicate that one disadvantage of windbreaks and shelterbelts is root extension into adjacent cropland. Working in the eastern portion of the Plains, Bates (*1*) found that some of the basic conditions which influence root spreading were: Species of tree, rainfall, texture and fertility of soil, and competition from other species within a planting.

Observations at a number of field stations in Wyoming, Kansas, Colorado, Oklahoma, Texas, and North Dakota show that windbreak competition with adjacent crops becomes more acute from east to west (sub-humid to arid), and from north to south (reduced snow contribution and higher temperatures) (*4, 5, 6*).

B. W. Greb and A. L. Black are soil scientists with the Agricultural Research Service, U.S. Department of Agriculture and they headquarter at Akron, Colorado. Cooperating on the study reported in this article were the Soil and Water Conservation Reseach Division, Agricultural Research Service, U.S. Department of Agriculture and the Colorado Agricultural Experiment Station.

Actual data for root extension effects in more arid regions is limited. At the Akron station it was shown that broadleaf trees 18-20 years old developed shallow root systems, 1-3 feet from the soil surface, that extended horizontally for considerable distances (*5*). Tap roots were lacking or turned at right angles. This indicated the roots were responding to soil moisture conditions. Established field crop variety testing had to be abandoned during the 1930's within 50 to 100 feet of the windbreak because of tree root extension.

In view of the advanced age (45-50 years) and possible future renovation of portions of the original plantings at Akron, it was decided in 1957 to obtain some measurements of effects on crop yields, soil moisture, extension of roots at selected sites, and soil fertility effects of windbreaks.

Experimental Procedure

The original tree planting experiments at the Akron station are well described and diagrammatically shown by Preston and Brandon (*5*). Positions of the 1957-1959 tree survival stands are shown on figure 1. The sketch is not to scale but demonstrates relative position of plantings and sampling. The species used for sampling measurements were healthy except for black locust in which the older trunks had died out and had been replaced by sucker growth.

Cropping

The fields adjacent to the east and north windbreaks were summer-fallowed in 1956 and planted to winter wheat that fall. Excellent growing conditions prevailed throughout the 1957 season. High yields of grain and straw were harvested (table 1).

The wheat stubble was subtilled early in the fall of 1957 and disk tilled twice in the spring of 1958 in preparation for grain sorghum planting. Sorghum (Reliance) was surface drilled June 6 and an excellent stand was obtained. It was cultivated twice with narrow sweep blades. High yield prospects were nullified by dry weather during August and early September. Conventional summer-fallow tillage was employed throughout the 1959 season with sweep and rod weeding operations as needed to control weeds. The cropping sequence for the land adjacent to the west windbreak included summer fallow in 1957, sudan grass in 1958, and summer fallow in 1959.

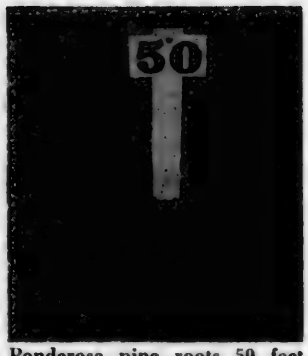
Harvesting

Hand sampling was used at predetermined distances of 30, 50, 70, 90, 110, and 130 feet at right angles from

TABLE 1
Yield of Winter Wheat Adjacent to Windbreak, Central Great Plains Field Station, Akron, Colorado, 1957.

Distance from Windbreak	Ponderosa Pine			Siberian Pea and Chokecherry			Broadleaf[1]		
	Grain	Straw	Test Weight	Grain	Straw	Test Weight	Grain	Straw	Test Weight
feet	bu./ac.	t./ac.	lbs./bu.	bu./ac.	t./ac.	lbs./bu.	bu./ac.	t./ac.	lbs./bu.
30	3.0	.33	58	14.1	1.71	60	2.3	.31	57
50	4.7	.41	58	30.2	3.08	60	6.2	.86	58
70	23.5	2.56	61	30.3	3.35	60	6.6	1.01	60
90	32.4	3.57	60	27.6	3.51	60	14.6	1.67	60
110	33.8	3.66	61	33.9	3.95	60	22.3	2.47	61
130	32.4	3.67	60	24.6	3.17	60	25.6	3.15	62

[1] Broadleaf = black walnut and black locust.



Ponderosa pine roots 50 feet from tree into cultivated field.

the plantings as shown in figure 1. At each sampling location, two rows 8 feet long were harvested to determine wheat yields in 1957. Similar techniques were employed for grain sorghum. The sorghum bundles were weighed immediately after cutting for total wet forage (stalk heads). The bundles were then air dried, the grain threshed and weight of grain and residue determined.

Soils

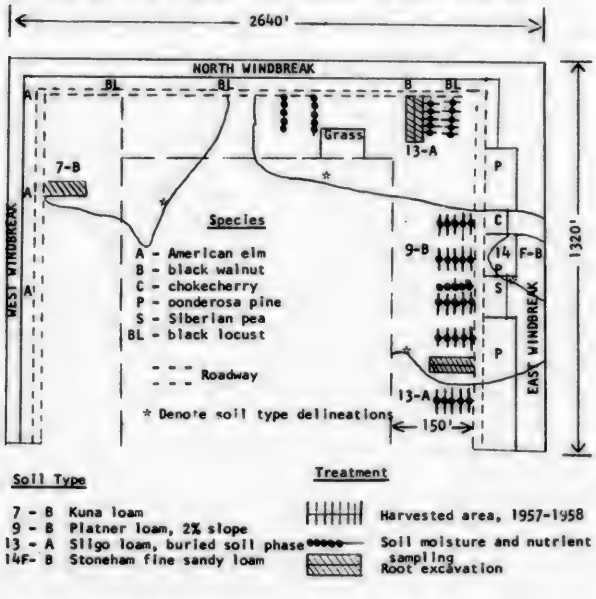
The soils are typical of the calcareous gently rolling "hardlands" of eastern Colorado. Sligo loam, buried soil phase, in the northeast corner of the plantings represents a depression topography while Stoneham fine sandy loam is on a crest. Stoneham soils are shallow and underlain with fine gravel. Platner loam covers broad level uplands of the region, somewhat deeper in profile than Stoneham but still underlain with fine gravel.

Gravimetric samplings for available soil moisture determinations were made July 2, 1958, on growing sorghum and again at the end of fallow in 1959 at locations shown on figure 1. Available soil moisture was calculated on the basis of 8 percent moisture as wilting point; this is near average for the soils involved.

Composite soil samples (0-3 feet in depth) for nutrient determination were taken at the same interval distance and position as for soil moisture. The samples were analyzed for organic matter by wet combustion, for nitrates by phenoldisulphonic acid, and for available phosphorus by sodium bicarbonate extraction.

A 2.5 yard earth remover for shearing off top soil was used in October 1959 to examine root development of American elm, black walnut, ponderosa pine, and Siberian pea.

Figure 1. Diagram showing positions and species of windbreak plantings, sampling areas for root extension, and soil type at the Central Great Plains Field Station, Akron, Colorado.



Climate

The 50-year average of rainfall at the Akron station is 17.1 inches and snowfall averages 32 inches. Snowfall is highly variable but it is an important factor in windbreak survival. Windbreaks and shelterbelts in the region are partially self-irrigating mechanisms from the snow trapped in and adjacent to the plantings. Climatic data for the 3-year testing period and the 50-year record is condensed in table 2.

During the three winter seasons of this investigation, two snow storms produced significant moisture contributions to crop land immediately adjacent to the windbreak. The storm of November 2, 1956, produced a 3-foot snow drift 60 feet in width immediately east of the east windbreak and immediately south of the north windbreak. A second storm, on March 24, 1959, deposited a 1.5 foot drift averaging 40-45 feet in width in the same places.

Significant runoff and temporary ponding on one occasion during the 3-year study was caused by a heavy rainstorm in July 1959 which flooded the land adjacent to the black walnut and black locust windbreak on the north and was reflected in higher total stored soil moisture during fallow (table 3). The last column of table 3 indicates the flooded area was 90 feet or more from the windbreak.

Crop Yield

Winter Wheat—1957

Growing conditions were favorable throughout the season, but grain yields were reduced 15-20 percent by hail. By May 1, extreme nitrogen deficiency and moisture shortage were in evidence on wheat adjacent to both the ponderosa pine and broadleaf species despite the extra moisture contribution from snow the previous fall. The primary effect was a very great difference in the color, height, and tillering of wheat in the area from the pine to a sharp line 55 feet away. A secondary spotty effect up to 85 feet from the windbreak was noted (table 1). The wheat near the Siberian pea and chokecherry bushes did not appear to be affected beyond 40 feet into the field. Affected wheat ripened 10 days later than that in the main field.

The effects of broadleaf species in the north field were gradually reduced with distance, the break was not so sharply defined as on wheat adjacent to the pine.

Yields of grain and straw confirmed the observation regarding the areas affected by the types of windbreak material. Normal production was regained at distances of 90, 50, and 130 feet respectively from the pine, bushes and broadleaf.

Grain Sorghum—1958

The same general areas that showed root sapping on wheat were also affected in grain sorghum (table 5). The effect on sorghum was progressively more pronounced after July 20 with the beginning of rapid elongation of plants. Dry weather conditions in late August and early September promoted moisture stress throughout the field. Bulk harvest of the main field exclusive of the affected area gave a 14.5 bushel per acre yield.

Early in May, an application of 25 pounds of nitrogen per acre (ammonium nitrate—33.5 percent N) was made in an 8-foot strip 40-50 feet in the sorghum field and parallel to the windbreak. The fertilizer produced an early vegetative response on the sorghum but continued root sapping reduced the yield and the vegetative response to fertilizer disappeared. This indicated that nitrogen deficiency as well as moisture stress may be caused by competitive root sapping.

Yields of total wet forage, grain, and dry residue of sorghum were affected much as wheat yields had been the previous season (table 5).

TABLE 2
Climatic Summary of 1957-1959 Period and 50-Year Average, Central Great Plains Field Station, Akron, Colorado.

Crop Season	Total Rainfall	Rainfall Mar.-Sept.	Seasonal Temperature	Total Snow Fall[1] Oct.-Apr.
	inches	inches	°F.	inches
1957	18.07	12.60	61	67
1958	14.38	10.09	64	28
1959	13.77	9.97	65	19
1909-1959	17.10	11.51	63	32

[1] Period beginning fall of previous year.

TABLE 3
Available Soil Moisture, End of Fallow, September 10, 1959, Central Great Plains Field Station, Akron, Colorado.

Distance from Windbreak	Ponderosa Pine	Siberian Pea & Chokecherry	Black Walnut Black Locust
feet	inches	inches	inches
30	.4	2.5	.2
50	.8	2.9	2.0
70	2.1	3.3	3.9
90	3.1	2.9	4.9
110	3.1	3.3	5.6

TABLE 4
Available Soil Moisture Under Sorghum, July 2, 1958. Central Great Plains Field Station, Akron, Colorado.

Distance from Windbreak	Ponderosa Pine	Siberian Pea & Chokecherry	Black Walnut Black Locust
feet	inches	inches	inches
30	1.0	1.8	0.9
70	1.9	2.1	0.9
110	2.2	2.5	1.8

[1] Means of four samples at each location.

Soil Moisture

As the distance from given windbreak materials increased, the amount of available soil moisture decreased during the sorghum growing season (table 4). Total moisture was low at the time of sampling.

Soil moisture extraction by roots during fallow correlated with yield reductions observed for wheat and sorghum (tables 1, 3, and 5). Of the four broadleaf species only the black walnut showed serious moisture sapping at a distance of 90 feet.

American elm root 92 feet from tree. It is 0.25 inch in diameter at this point.

TABLE 5
Yield of Sorghum Adjacent to Windbreak, Central Great Plains Field Station, Akron, Colorado, 1958.

Distance from Windbreak	Ponderosa Pine			Siberian Pea and Chokecherry			Broadleaf[1]		
	Wet Forage	Dry Residue	Grain	Wet Forage	Dry Residue	Grain	Wet Forage	Dry Residue	Grain
feet	t./ac.	t./ac.	bu./ac.	t./ac.	t./ac.	bu./ac.	t./ac.	t./ac.	bu./ac.
30	.92	.41	3.6	2.34	.96	15.1	.79	.33	1.2
50	1.23	.53	6.8	2.60	.94	12.7	1.23	.55	9.2
70	1.91	.75	11.1	2.49	.89	12.9	1.04	.42	6.0
90	2.51	.98	13.6	2.68	1.02	12.9	1.58	.63	9.6
110	2.57	.95	13.5	2.95	1.20	12.9	3.08	1.17	16.0
130	—	—	—	—	—	—	3.20	1.28	20.4

[1] Broadleaf = black walnut and black locust.

TABLE 6
Root Extension into Test Field, Selected Sites, Central Great Plains Field Station, Akron, Colorado, October 1959.

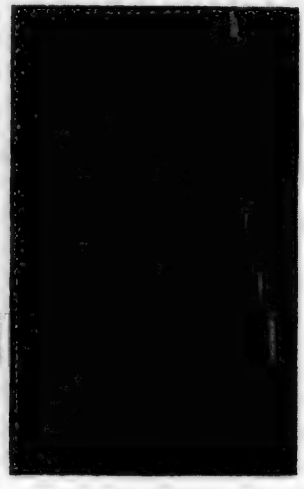
	Age	Height	Diameter[1] Trunk	Ave. Depth Main Roots	Root Diameter at Indicated Distance from Trunk 30 Feet	50 Feet	70 Feet	90 Feet	110 Feet	Maximum Distance—Roots from Trunk	Root-Height Ratio
	years	feet	inches	inches	inches	inches	inches	inches	inches	feet	
American elm	49	26	16.0	12-14	1¼	1	¾	¼	fibers	112	4.3:1
Black walnut	49	29	11.5	14-16	3	1½	1¼	½	fibers	112	3.9:1
Ponderosa pine	47	31	15.0	9-12	¾	½	⅛	—	—	84	2.7:1
Siberian pea	23	9	—	9-12	fibers	—	—	—	—	36	4.0:1

[1] Measured two feet above base level.

Observations on Excavated Roots

When exposed by excavation, the roots of the American elm, black walnut, ponderosa pine, and Siberian pea were found to be shallow, indicating lateral extension for nutrient and water requirements (table 6). Rootlets radiated upward and downward from the main roots. The quantity of rootlets on both the American elm and black walnut specimens decreased rapidly as the distance from the trunk increased. Up to 50 feet from the tree the rooting system of the ponderosa pine was a mixture of numerous small diameter roots and fibers. Beyond 50 feet, the rooting system was predominantly smaller fibers and these ended 80 feet from the trunk. Siberian pea and chokecherry were planted more recently than the black walnut and black locust; therefore, their root development is proportionately smaller. Roots of these species did not extend beyond 36 feet from their trunks.

(Below) Black Walnut root 35 feet from tree. Stake is 1.75 inches wide. (Right) The same root extends 112 feet into cultivated field.



The general pattern of root distribution found by excavation correlated well with the observations of decreased growth and yield of wheat and sorghum (tables 1 and 5), with soil moisture extraction (table 3), and with nitrate nitrogen levels (table 7).

Soil Analysis

The analyses of root extension effect on organic matter and available phosphorus were not conclusive. The levels of these soil characteristics were more a function of soil type than any other factor. Platner loam adjacent to the Siberian pea and pine was low in organic matter and phosphorus. The level of organic matter and phosphorus was considerably higher adjacent to the black walnut, black locust and chokecherry. Sampling at 0-3 foot depths tended to dilute the average percentage of organic matter. There was some speculation that organic matter content of soil would increase closer to the trees as the result of root decay, but there was no evidence that this was the case in the cultivated field area. No analysis was made of the soil directly under the tree canopy. There was a slight trend toward higher phosphorus levels closer to the windbreak but a more detailed analysis would have to be made to see if the trend was real.

Nitrate-nitrogen levels after summer fallow appeared to be a function of both initial organic matter levels and root sapping. There was a fairly sharp increase in nitrate nitrogen levels between the 70 and 90 foot sampling points for pine and between the 50 and 70 foot sampling points for bushes and broadleaf species (table 7). In each of the broadleaf check areas, there was a higher nitrate accumulation 70 feet from the tree than at the 50 and 90 foot sampling points. Whether this indicated zone of inactive feeding at the time the samples were taken is not known. Soil moisture samples taken at the same time did not show this particular phenomena.

TABLE 7
Level of Organic Matter, Nitrate Nitrogen and Available Phosphorus, as a Function of Distance from Windbreak, Central Great Plains Field Station, Akron, Colorado.

Distance from Windbreak	Ponderosa Pine			Siberian Pea and Chokecherry			Broadleaf[1]		
	O.M.	NO_3—N	P_2O_5	O.M.	NO_3—N	P_2O_5	O.M.	NO_3—N	P_2O_5
feet	percent	lbs./ac.	lbs./ac.	percent	lbs./ac.	lbs./ac.	percent	lbs./ac.	lbs./ac.
30	.59	41	68	1.01	56	74	1.02	54	153
50	.71	33	51	1.12	72	75	1.03	74	147
70	.67	38	43	1.04	93	67	1.05	153	142
90	.69	60	49	.96	92	61	1.03	120	128
110	.73	65	60	—	—	—	.99	124	123

[1] Broadleaf = black walnut and black locust.

Summary

Root extensions by windbreak materials is an accepted hazard in semi-arid regions. The total area of

farmland occupied by windbreaks is very small. Observations in northeastern Colorado indicate that sapping has little effect on native and introduced grass plantings but does depress growth and yields of adjacent annual crops. It appears that broadleaf trees are more competitive in this respect than are conifers. Conifer plantings at Akron have shown little sapping effect until 10-15 years after establishment from seedlings. Broadleaf plantings in the area show serious sapping into crop land up to a distance of 50 feet within 5-8 years. Bush type species apparently have a very minor effect on adjacent crops.

The data obtained from the Akron plantings showed a direct yield reduction in wheat and sorghum attributed to extraction of water and some nitrate nitrogen as far as windbreak planting roots extended into the field. The deleterious effects of windbreak root extension were gradually reduced as distance from the windbreak increased. Excavated roots were very shallow and indicated possible growth extension for water. The ratio of root length to tree height was more than 2.5:1 in the cases tested.

The ability to trap snow within and around a planting is helpful for the survival of shelterbelts and windbreaks in low rainfall areas.

REFERENCES CITED

1. Bates, C. G. 1911. *Windbreaks: their influence and value.* F. S. Bul. 86 U. S. Dept. Agr., Washington, D. C.
2. Boylshev, N. N., and Solov'yev. 1958. *Soil investigation methods on State farms organized on virgin soil.* Soviet Soil Science 4:388-396.
3. Chernikov, F. S. 1958. *Temperature relations in light-chestnut Yergeni clay loam in fields and under a shelterbelt.* Soviet Soil Science 4:402-408.
4. George, E. J. 1953. *Thirty-one year results in growing shelterbelts on the Northern Great Plains.* Cir. 924. U. S. Dept. Agr., Washington, D. C.
5. Preston, R. J., Jr., and J. F. Brandon. 1946. *Thirty-seven years of windbreak planting at Akron, Colorado.* Bul. 492. Colo. Agr. Exp. Sta., Fort Collins.
6. Staple, W. J., and J. J. Lehane. 1955. *The influence of shelterbelts on wind velocity, evaporation, and crop yield.* Can. J. Agri. Sci. 35:440-453.

Adjustments in Agriculture—A National Basebook. *Editors:* MERVIN G. SMITH *and* CARLTON F. CHRISTIAN. *376 pp., illus., refs., index, 1961. Iowa State University Press, Ames, Iowa. $3.95. (Reviewed by* MARION CLAWSON, *Washington, D. C.)*

American agriculture is in trouble: burdensome surpluses and serious poverty are its twin problems. Since the war, in a period when the total economy has been moving forward, agriculture has lost ground relatively. Agricultural incomes have been stagnant or even declined, and large segments of the farm population are stranded under conditions from which they cannot well extricate themselves unaided. Though government help has been large and growing, it has not cured the basic difficulties.

This general situation is well known to every student of American agriculture, but the general picture needs sharpening, such as comes when a telescope or camera is brought into proper focus. A sharp clear focus is what emerges from this book.

It is a wonderfully informative book. Nineteen of the nation's best agricultural economists and editors have collaborated to prepare its thirteen chapters. These articles are solid, full of information, balanced in their presentation, yet nontechnical. It is a serious book, thoughtful and thought-provoking, yet designed and suitable for the nonspecialist. It should be especially valuable to county agents, vocational agricultural teachers, work unit conservationists, and others deeply concerned with agriculture who are not professional economists. I can recommend it unreservedly as a good buy for such people.

Each chapter presents information and analysis relevant to the particular subject. Demand, supply, land use, livestock production, farm size, human resources, community facilities, government programs, education—all these, and more, are treated carefully, thoroughly, yet reasonably briefly. The difficult problems are set forth clearly, honestly, sympathetically, but unemotionally. Sometimes, but not always, alternative lines of solution are offered, in general terms, without an effort at "selling".

This book makes doubly clear: American agriculture faces major adjustments in the years ahead. Its productivity is mounting faster than is the demand for its products, with the result that surpluses are mounting, not declining. There are small prospects of increasing total food demand, by any reasonable measures, domestic or foreign. Farmers are under severe pressure to adopt each new technology that will reduce their own costs, even though the result is a larger volume and lower prices for all. There are far too many people now

seeking a living from agriculture, and fewer still will be needed in the years ahead. Adjustment will not be easy nor cheap. How can it best be done, for farmers and the Nation alike? There are no final answers in this book; but no answer can evolve that is not built upon the kind of information contained here.

American Forestry—Six Decades of Growth. HENRY CLEPPER AND ARTHUR B. MEYER, *Editors. 319 pp., index, 1960. The Society of American Foresters, 425 Mills Building, Washington 6, D. C. $5.00. (Reviewed by* JAMES C. RETTIE, *Washington, D. C.)*

Issued to commemorate the 60th anniversary of the Society of American Foresters, this volume gives a panoramic view of the birth and growth of forestry in the United States since 1900. Its 20 chapters are contributed by persons well known in forestry circles.

For people who think of foresters as men who spend their time growing trees to be cut down for lumber and other timber products, this book may be something of a revelation. Only three chapters deal strictly with the technology of timber production and utilization. Other aspects of forest land management given chapter-treatment include: Watershed management, forest-wildlife management, forest-range management, and recreational use of forest lands. Additional topics discussed include: Forestry activities of the Department of Agriculture, Department of Interior, and of several other Federal agencies that administer forested lands; state forestry, industrial forestry, and farm forestry; forestry education, forestry research, forestry literature, and professional organization exemplified in the Society of American Foresters. The last two chapters of the book describe the many citizen associations and trade associations concerned with forestry matters, and also the ever-expanding contacts of American foresters with the foresters and forest problems of other countries.

Any symposium, reflecting different points of view, is difficult to review. If there is a central theme in this one, it may be the conviction that foresters and forestry need a broadened outlook. Duncan and Kaufert, members of the University of Minnesota School of Forestry faculty, put the challenge in bold language: "Forestry education, if it is to provide adequate professional leadership in an increasingly complex society, must insure that prospective foresters demonstrate a high level of intellectual capacity, an understanding of and interest in people, and a broad yet thorough technical background. The profession must encourage the most able young men to enter the field, at the same time recognizing a need for the less gifted. Education must stimulate in all a broad interest in human affairs. It must provide insight into forest management, recognizing not only responsibility for the production of wood, but for the provision of water, forage, recreation, and wildlife as well. Forestry education in 1960 requires more of its graduates than could have been expected in earlier years."

It would be interesting to know whether kindred workers in the resources-conservation garden also feel the need for broadened intellectual horizons. Is this a common need of all persons concerned with the conservation and management of our natural resources? Or are the foresters alone in their struggle to break out of narrowly-conceived professionalism—always threatening to encrust professional people?

The Use of Chemicals in Southern Forests. ROBERT W. MCDERMID, *Editor. 152 pp., illus., refs., 1961. Louisiana State University Press, Baton Rouge 3, Louisiana. $4.00. (Reviewed by* JAMES L. SMITH, *Washington, D. C.)*

The Proceedings of the Ninth Annual Forestry Symposium of Louisiana University examine the progress which has been made in utilizing chemicals as forest management tools in the fields of fertilization, herbicides, and protection.

The Proceedings consist of 12 short papers. Many readers will feel that the subjects should have been explored more minutely. However, no short meeting could cover the whole of the three fields. It is enough that such a meeting excite the curiosity of the participants to the point they will dig deeper into the subjects presented. For these people, most of the papers include extensive bibliographies.

Since space limitations do not permit review of all papers, only those having major appeal will be covered here. Interested readers will find a personal examination of all the papers rewarding.

Willis' "Basic Problems in Nutrition Research" summarizes the current knowledge about forest fertilization, the roles of nitrogen, phosphorus and potash in forestry and the effect of some management practices (such as burning) upon them.

Kirch's paper, "Foliar Application of Chemicals to Weed Tree Species," summarizes current knowledge about the physiological effects induced in trees by spraying.

De Silvia's "Modern Fire Fighting with Chemicals" previews the techniques of aerial firefighting that are sure to become the tools of firefighters in the South and East that they currently are in the mountainous West.

Beal's "Combating Forest Insects with Chemicals" is a summary of the chemicals now in use (including systemics), methods of application, effect of treatment upon parasites and other pests, and an evaluation of the possibility of a buildup of immunity to control measures.

"Possible Effects of Widespread Use of Forest Chemicals on Wildlife Populations" by George of the U. S. Fish and Wildlife Service, is a welcome evaluation that recognizes the need for controlling forest pests, while pointing out the effects of the treatments now in use. His evaluation should cause an increased awareness of management's responsibilities in safeguarding wildlife and fish resources in the planning and execution of needed insect control measures.

The annual forest symposia of Louisiana State University, along with their proceedings, have become a familiar part of American forestry. Proceedings of the ninth symposium, like those of the first eight, will be a valuable addition to the bookshelves of forest land managers.

Agricultural Engineer's Handbook. *Editors:* C. B. RICHEY *(editor-in-chief)*, PAUL JACOBSON *and* CARL W. HALL. *880 pp., illus., refs., index, 1961. McGraw Hill Book Company, 330 West 42nd Street, New York 36, N. Y. $19.50. (Reviewed by* ROBERT KOHNKE, *Milwaukee, Wisconsin.)*

This book is the first handbook prepared for agricultural engineers. The text was written and prepared by more than 40 recognized authorities in all areas of agricultural engineering. Concise and well prepared, it contains valuable reference lists and tabular materials in in addition to the discussions of fundamentals.

Section I, "Crop Production Equipment", covers farm tractors and other farm implements. Introductory chapters in this section deal with economics, design of field machinery, wheels and tires, and power-transmission elements. Five chapters on tractors relate to tractor force reactions, design objectives, performance tests, fuels, combustion, and power controls for implements. Chapters devoted to classes of implements discuss the general types and requirements, functional elements, power requirements and design problems.

Section II, "Soil and Water Conservation", deals with agricultural land drainage, irrigation and related practices, wind and water erosion, erosion control structures and practices, hydrology, frost control, and water management. Most of the materials and methods presented have been used by the U.S. Department of Agriculture but have not previously been available to the public in this convenient form.

Section III, "Farmstead Structures and Equipment", is concerned with the structural and functional requirements and the control of heat, air and moisture in farm buildings.

Section IV, "Basic Agricultural Data", presents carefully selected data on livestock, soils, plant food, climate, and solar energy, which affect the solutions of agricultural engineering problems.

This excellent book will be a reference of lasting value for students, teachers, and practicing engineers.

Forest Management. *Second edition by* H. ARTHUR MEYER, ARTHUR B. RECKNAGEL, DONALD D. STEVENSON, *and* RONALD A. BARTOO. *282 pp., illus., refs., index, 1961. The Ronald Press, 15 East 26th Street, New York 10, N. Y. $8.50. (Reviewed by* AUGUSTINE J. STREINZ, *Atlanta, Georgia.)*

Nine years after the publication of the first edition of *Forest Management* it has been advisable to publish a second edition because of the considerable advances in forest management and the accumulation of experience in the development of sustained-yield management of forest properties.

The first edition was published as a textbook useful to forestry students and practicing foresters. In the second edition emphasis is placed on the application of technical forestry to the operation of a specific forest property. This, together with the introduction of recent material, has resulted in a complete revision that should be much more useful to practicing foresters.

Parts I and II, "Organization of Forest Property for Management", and "Regulation" describe: (1) The considerations basic to the organization and operation of a forest property for sustained-yield, (2) the subdivision and classification of the forest, and (3) the determination and distribution of the allowable cut.

In Chapter 6, ten methods of determining the allowable cut and six systems of forest management in contemporary use are described. Included in the methods described are the recent methods developed by W. H. Meyer (1952) and L. R. Grosenbaugh (1958). In one of the four examples of actual management plans, Coeur d'Alene Working Circle, Coeur d'Alene National Forest, Paul Kemp's formula is employed to determine the allowable cut. It is unfortunate that Kemp's formula was neither described in detail nor listed among the references at the end of Chapter 6.

Part III, "Management," describes: "The Preparation of Management Plans," Chapter 7; "Control and Revision of Management Plans," Chapter 8; and "The Forest as a Business Enterprise," Chapter 9. The latter chapter discusses the impact of forest taxation, income taxes, compensation insurance, the Fair Labor Standards Act, and social security on the management of a forest as a business enterprise.

Part IV is a brief account of the history and present status of forest management. For those interested in extending their knowledge of this field, many pertinent references are listed at the end of the chapter.

The appendix to this book presents four actual management plans "to show what actual management plans look like and to exemplify the principles of management plans which the previous chapters have set forth." The second edition of *Forest Management* is a useful book for the practicing forester to have on his bookshelf.

Current Literature Briefs

Soil and Water

Ground Water and the Law. *H. E. Thomas.* 6 pp., 1961. Circular 446. U.S. Geological Survey, Washington 25, D.C. (Single copies free).

Soil, Water, and Crop Management on Newly Irrigated Lands in the Dakotas. *C. W. Carlson* et al. 34 pp., illus., refs., 1961. Production Research Report No. 53. Agricultural Research Service, U.S. Department of Agriculture, Washington 25, D.C.

Watershed and Related Water Management Problems: Proceedings of the Fourth Annual Arizona Watershed Symposium (1960). 44 pp., illus., 1960. Watershed Management Division, State Land Department, Phoenix 7, Arizona.

Engineering Soil Classification for Residential Developments. 107 pp., 1959. U.S. Government Printing Office, Washington 25, D.C. $0.75.

Compiled and edited by the Federal Housing Administration from data prepared by the Bureau of Public Roads and the Virginia Polytechnic Institute, this manual was designed to supplement the existing engineering system of soil classification by emphasizing engineering soil data significant to residential construction. This manual also contains soil engineering data prepared by the Bureau of Public Roads on the significant engineering characteristics of about 400 representative soil series from all sections of the country.

FHA Soil PVC Meter. 112 pp., 1960. FHA-701. Federal Housing Administration, Washington 25, D.C.

This report, completed for the Technical Studies Program of FHA, includes the research background, an explanation of the laboratory testing conducted in the development of this soil testing device and instructions for the meter's operation and use. The PVC Meter is a small apparatus designed to measure the swell index of clay soils.

Progress in the Application of Landform Analysis in Studies of Semi-arid Erosion. *S. A. Schumm* and *R. F. Hadley.* 14 pp., illus., refs., 1961. Circular 437. U.S. Geological Survey, Washington 25, D.C. (Single copies free).

Ground Water Resources—Development and Management. *C. S. Conover.* 7 pp., 1961. Circular 442. U.S. Geological Survey, Washington 25, D.C. (Single copies free.)

Effect of Sediment Characteristics on Erosion and Deposition in Ephemeral-Stream Channels. *S. A. Schumm.* 70 pp., illus., refs., 1961. Geological Survey Professional Paper 352-C U.S. Government Printing Office, Washington 25, D.C. $0.45.

Peak Rates of Runoff from Small Watersheds. *William D. Potter.* 35 pp., illus., refs., 1961. U.S. Department of Commerce Hydraulic Design Series No. 2. U.S. Government Printing Office, Washington 25, D.C. $0.30.

Make Your Water Supply Safe. *N. Henry Woodring, Jr.* 8 pp., 1961. Special Circular 45 (revised). Extension Service, Pennsylvania State University, University Park, Pa.

Getting the Most Out of Water Resources. *Irving K. Fox* and *Henry P. Caulfield, Jr.* 8 pp., 1961. Reprint Number 28. Resources for the Future, Inc., 1775 Massachusetts Avenue, N.W., Washington 6, D.C. (Single copies free).

Arid Zones Research

Salinity Problems of the Arid Zones: Proceedings of the Teheran Symposium. United Nations Economic, Social and Cultural Organization. 344 pp., paperback, bilingual—English and French, 1961. International Documents Service, Columbia University Press, 2960 Broadway, New York 27, N.Y. $8.00.

This book includes the papers presented to the symposium, grouped in four sections: Hydrology with reference to salinity, physiology of plants and animals in relation to consumption of saline water, irrigation with brackish water and saline soils, and demineralization of saline water.

Also published by the United Nations Economic, Social and Cultural Organization and available from the International Documents Service of Columbia University Press:

Plant-Water Relationships in Arid and Semi-arid Conditions: Reviews of Research. 225 pp., paperback, 1960. $6.00.

Topics included in this book: The income and loss of water in arid and semi-arid zones, soil-water relation in arid and semi-arid conditions, physiological and morphological changes in plants due to water deficiency, plant adaptation to drought, methods of research on water relations, management of native vegetation in arid and semi-arid regions, principles of dryland and crop management, significance of fallow as a management technique in continental and winter rainfall climates, and principles of irrigated cropping.

A History of Land Use in Arid Regions. *L. Dudley Stamp,* editor. 440 pp., paperback, 1961. $10.50.

This work is intended primarily for those having a practical interest in improving the utilization of arid and semi-arid lands; it does not attempt to cover the history of agriculture in certain geographical regions, though it is divided into chapters devoted to the main geographical regions of the arid world. Special chapters deal with climate and its variations since the Pliocene Age and with public health hazards in land use.

Arid Zone is the title of a quarterly newsletter published by the United Nations Economic, Social and Cultural Organization. Its aim is "to facilitate the closest possible liaison between specialists and give the widest possible publicity to the activities and to the measures adopted by various Member States." The most recent issue (No. 12, June 1961) was 32 pages in length. It contained articles dealing with plans for the publication of a soil map of the world, arid zone research in Pakistan, a progress report on the international sourcebook on irrigation and drainage, a brief description of UNESCO's arid zone fellowship program, a report on the Australian arid zone technical conference and various news items. The newsletter will be sent free upon request to: United States National Commission for UNESCO, Department of State, Washington 25, D. C.

Conservation Education

Forestry for Minnesota Schools. 74 pp., illus., 8½" x 11", 1961. Minnesota Education Association, 41 Sherburne Avenue, St. Paul 3, Minn. $1.25.

Prepared under the direction of the Minnesota Division of Forestry, this conservation education tool is designed for classroom use. At the end of each chapter are valuable lists of interesting student projects.

A Guide to Teaching Conservation in Ohio Elementary Schools. Editors: Charles Dambach and Robert Finlay. 127 pp., illus., 1961. Ohio Forestry Association, Inc., Columbus 15, Ohio. $3.00.

This excellent work is a cooperative project of the Ohio Department of Education, Ohio State University and the Ohio Forestry Association. It is organized into eight sections as follows: "Conservation

Education as a Function of the Elementary School," "Planning and Organization for Conservation Learning," "Conservation Understandings," "Development of Selected Generalizations," "Sample Teaching Units," "Providing Firsthand Experiences for Conservation Education," "Conservation Education and Information Sources," and a bibliography.

Your Future in Forestry. *David H. Hanaburgh.* 159 pp., 1961. Richards Rosen Press, 13 East 22nd Street, New York 10, N.Y. $2.95.

This excellent work should have a prominent place in the libraries of those who counsel youths and others concerning the choice of a career. Written in an easy to read style, individuals who want to explore in depth a possible career in forestry would do well to spend several hours of study with this book. It is not a glamourized promotion piece, but rather an objective study of forestry as a career. A valuable feature is the final two chapters which are devoted to lists of information agencies and information literature concerning forestry.

Forestry Activities. U.S. Forest Service. 31 pp., illus., 1961. PA-457. U.S. Government Printing Office, Washington 25, D.C. $0.15.

This pamphlet, published as a guide for youth group leaders, presents details on a large number of interesting science projects and practical activities relating to forest conservation.

Economics

State Action Relating to Taxation of Farmland on the Rural-Urban Fringe. *Peter House.* 23 pp., 1961. ERS-13. Economic Research Service, U.S. Department of Agriculture, Washington 25, D.C.

Opportunities for Economic Development in Low-Production Farm Areas. 38 pp., illus., refs., 1960. Agriculture Information Bulletin No. 234. U. S. Government Printing Office, Washington 25, D. C. $0.25.

This publication brings together the findings and results of seven of the research studies conducted by the Agricultural Research Service under the auspices of the Rural Development Program of the U. S. Department of Agriculture.

Economics of Public Water Pricing. *Michael F. Brewer.* 33 pp., 1961 Giannini Foundation Research Report No. 244. California Agricultural Experiment Station, Berkeley 4, California.

Farm Costs and Returns: Commercial Farms by Type, Size and Location. 35 pp., illus., 1961. Agriculture Information Bulletin 230. Economic Research Service, U.S. Department of Agriculture, Washington 25, D.C.

An Assessment of Investments in Land Reclamation. 65 pp., illus., 1960. International Institute for Land Reclamation and Improvement, P. O. B 35, Wageningen, The Netherlands. $1.50.

This is a study of investments in land reclamation from the point of view of the national economy in The Netherlands. These studies go back to well before World War II.

Three Studies in Mineral Economics. *Orris C. Herfindahl.* 63 pp., 1961. Resources for the Future, Inc., 1775 Massachusetts Avenue, Washington 6, D. .C. $1.00.

This booklet opens with a 12 page, lucid treatise on "What Is Conservation?" For this paper alone the booklet is valuable. The second of the studies is titled, "The Long Run Cost of Minerals" and the third is, "U.S. Trade for Minerals."

Also available from Resources for the Future is Reprint Number 26 (75 pages) which contains the following two papers presented at the 1958 National Bureau of Economic Research Conference on Income and Wealth. (Single copies free).

Measurement of Change in Natural Resource Economic Scarcity and Its Economic Effects. *Harold J. Barnett.* 1961.

Employment and Output in the Natural Resource Industries, 1870-1955. *Neal Potter* and *Francis T. Christy, Jr.* 1961.

General Interest

Words of the Earth. *Cedric Wright.* 95 pp., 10¼x13½ in., 53 illus., 1960. Sierra Club, Mills Tower, San Francisco 4, California. $12.50.

This book is of the same display format as *This is the American Earth.* The 53 excellent photographs are reproduced in the best gravure possible, and are more than merely a collection of nostalgic and beautiful pictures.

Proceedings of the Seventh General Assembly, International Union for Conservation of Nature and Natural Resources. 156 pp., mimeo., 1960. International Union for Conservation of Nature and Natural Resources, Morges (Vaud), Switzerland.

Report to the Government of India on Watershed Management and Research in India: Its Status and Potentialities. *Bernard Frank.* 37 pp., mimeo., 1960. Report No. 1236. Food and Agriculture Organization of the United Nations, Rome, Italy.

This report by Dr. Frank was the result of his participation last year in the Mission to initiate a program of forest influences (watershed management) research mainly under auspices of the Forest Research Institute at Dehra Dun, India. In addition to outlining specific suggestions concerning needed research some vital questions are raised relative to follow-up contacts with persons who have benefited from professional training in the United States and then return to India to pursue careers relating to renewable natural resource use and development.

The Rockefeller Foundation Program in the Agricultural Sciences—Annual Report. 292 pp., illus., 1960. The Rockefeller Foundation, 11 West 50th Street, New York, New York.

In addition to the general financial report of the Foundation including fellowship, scholarship and training awards, this book contains excellent descriptions of the specific research and aid programs developed by the Foundation in Mexico, Columbia, Chile, and India.

Tropical Soils and Vegetation: Proceedings of the Abidjan Symposium. United Nations Economic, Social and Cultural Organization. 115 pp., illus., paperback, bilingual—English and French, 1961. International Documents Service, Columbia University Press, 2960 Broadway, New York 27, N.Y. $4.25.

The book contains the papers presented to the symposium and includes presentations on the role of soil type as a determining ecological factor in the tropics, the influence of vegetation on soil organic matter, chemical analysis of runoff and percolating water, and systems of permanent exploitation of land with a combination of crops, animal husbandry, chemical fertilizers and organic manuring. Also included are papers dealing with the subtropical forests of Transcaucasia, cerrados of Brazil.

The Role of State and Local Governments in Meeting the Demand for Outdoor Recreation. 142 pp., 1961. Outdoor Recreation Resources Review Commission, Washington, D.C. (Single copies free).

This publication is the text of the proceedings of the fourth joint meeting of the Commission with its advisory council on March 12 and 13, 1961.

Notes from the Field

PLANT EARLY FOR MORE WINTER GRAZING

E. H. STEWART AND E. B. ESKEW

FALL PLANTED ANNUALS such as the small grains, ryegrass, rescuegrass and crimson clover constitute a very important part of the feed production program for livestock in the South. These crops are normally planted from mid-September to mid-November for grazing and/or grain production in the Piedmont region of South Carolina. In some areas of the South, farmers have had very good success with late July and early August plantings of ryegrass and crimson clover; these plantings have been extremely successful, particularly in the Tennessee Valley of northern Alabama.

Several advantages may be realized from August or early September plantings of these crops. A better distribution of the farmer's work-load during late summer and early fall may be accomplished. Soil moisture conditions are likely to be more favorable for stand establishment at that time, and there is a longer growth period before winter. This should furnish more fall grazing and earlier ground cover, aiding in better soil and water conservation. Early plantings are essential for effective use as green manure crops. Late September and October plantings often do not make sufficient growth to furnish grazing or ground cover before early spring. Such plantings are more likely to be winter killed by frost heaving. However, there are problems that may develop as a result of earlier plantings; grass and weed competition, diseases, insects and high temperature effects may cause trouble.

E. H. Stewart, soil scientist with the Agricultural Research Service is now headquartered at Fort Lauderdale, Florida, but at the time this article was written he was stationed at Clemson, South Carolina.

E. B. Eskew is associate agronomist with the South Carolina Agricultural Experiment Station, Clemson, South Carolina. *This article is Joint Technical Contribution No. 332 of the South Carolina Agricultural Experiment Station and the Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture.*

Procedure

Studies were conducted for 2 consecutive years at Clemson College to determine the effect of date of planting several forage crops on early forage production and ground cover. Plantings were made about the first and fifteenth of August, September, and October. Test crops the first year were oats, rye, barley, ryegrass, crimson clover, and a mixture of ryegrass and crimson clover. Rescuegrass was substituted for the clover-ryegrass mixture the second year.

The tests were conducted on a Cecil soil which varied from a sandy loam to sandy clay loam and is representative of a large portion of the Piedmont region. Fertilizer was applied at the rate of 600 pounds per acre of 4-12-12 before planting. Top dressings of nitrogen were applied at the rate of 30 pounds per acre of nitrogen in the fall and 60 pounds in the spring.

The small grains were planted in 8-inch drills and the grasses and clover were broadcast seeded. Irrigation was employed only when necessary to get the crops established on schedule. Periodic clippings of each species were made to obtain relative yields during the various seasons. These clippings were discontinued about the first of April and the final cutting was made at the normal hay stage of growth.

Weather

As shown in figure 1, weather during the period of August through October was quite different for the 2 years, thus providing a measure of the extremes that may be expected over a period of years. The first year's total rainfall of 2.42 inches for the 3-month period was considerably below normal; the following year it was near normal at 9.83 inches.

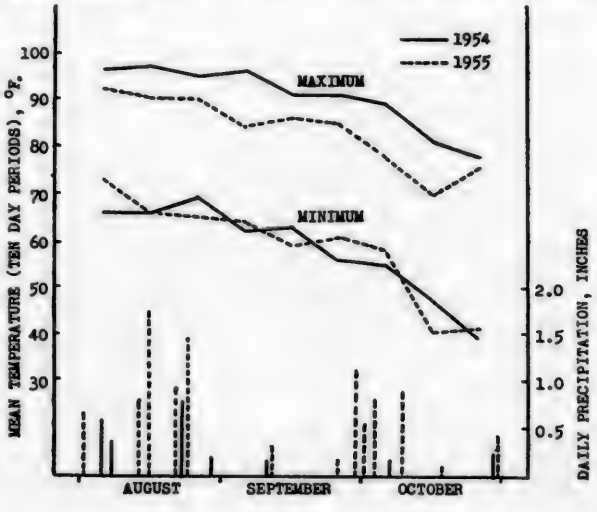
The 30-year averages of monthly rainfall data at Clemson, South Carolina, show 5.09, 4.60, 3.27, and 3.17 inches, respectively, for the months of July, August, September, and October. During August and September of the first year there were 32 days during which the temperature exceeded 95° F.; this condition occurred on only 2 days in 1955. The mean maximum temperature for this 3-month period in 1954 was 7° F. higher than in 1955 when the mean maximum temperatures were near normal.

Results

Forage yield data for 1954 are presented graphically in figure 2. Total forage produced by mid-February or early March represents the growth that would be available for grazing during the fall and winter. Under the more adverse conditions of the first year, mid- and late-September plantings of annual forage crops resulted in the most early grazing and greatest total forage production. August plantings of all crops produced the least amount of forage by mid-February; however, total yields of oats, ryegrass, and crimson clover were satisfactory. The earliest potential grazing was produced by the small grains with oats being the superior crop in both early and total forage production.

Adverse weather, insects, diseases, and grass competition killed most of the rye planted the first of August. These factors reduced stands and retarded early growth of the other species. Yields of the mid-August plantings were affected to some extent by these factors. Plantings made later than August were conspicuous be-

Figure 1. Mean temperature and daily precipitation during August, September and October 1954 and 1955 at Clemson, South Carolina.



cause of the absence of summer annual grasses. These grasses may not be objectionable since they may be grazed to reduce competition with winter annual seedings, thus furnishing earlier grazing and ground cover. In general, the crops were quite drought-resistant after receiving sufficient moisture at planting time to become well established.

Forage yields made in 1955 are presented in figure 3. Favorable moisture and temperature conditions during the planting periods that year resulted in the species tested becoming uniformly established. Considerable forage was produced before winter by the earlier plantings as shown in figure 4. Forage produced by mid-October from the August 1 and August 15 plantings consisted of about 40 and 15 percent summer annual grasses, respectively. These grass yields are not included in the data of figure 3. Yields of August plantings could be expected to be higher without competition from these grasses.

Approximately twice as much forage was produced by all the test crops by mid-February when planted on August 15 and September 1 as compared to the other dates of planting. October plantings of barley, oats, ryegrass, and rescuegrass produced about 800 pounds per acre of fall and winter forage; whereas, rye produced 1,400 pounds and crimson clover only 400 pounds per acre of forage during this period. Oats, rescuegrass and ryegrass produced about 4 tons per acre of total forage from all cuttings. Barley and rye produced over 3 tons and crimson clover yielded a little over 2.5 tons per acre.

The purposes for which these forage crops are grown and the prevailing environmental conditions should determine when a farmer will make his plantings. Available weather data from Clemson indicate moisture conditions for the Piedmont region are likely to be more favorable in August and early September than in late September and October. Early ground cover is very important during the summer and fall when most of the high intensity rain storms occur. Rescuegrass, ryegrass and crimson clover withstood the hot adverse conditions that occurred with the August plantings better than the small grains. Rye was the most susceptible to injury in the August plantings, and should not be planted before late August or September.

In general, the grasses and crimson clover may be planted effectively in early August and the small grains about 2 weeks later. Maximum ground cover for soil and water conservation may be obtained by planting these winter forage crops at the suggested early dates.

Figure 2. Yields of winter annual grazing crops by date of planting in 1954.

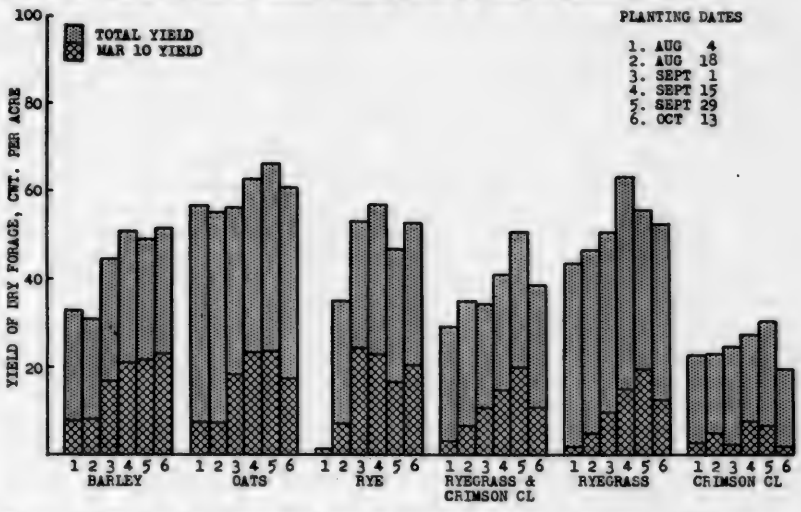


Figure 3. Yields of winter annual grazing crops by date of planting in 1955.

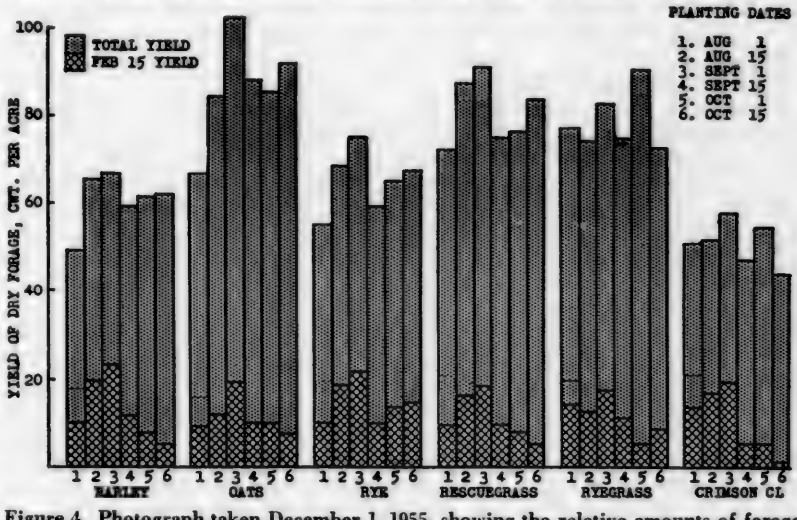


Figure 4. Photograph taken December 1, 1955, showing the relative amounts of forage produced by six winter forage crops planted October 15 (six plots in foreground) and plantings made September 1 (immediate background). The plots planted on September 1 were clipped October 11. Note the inadequate ground cover produced by crimson clover on plot immediately to right of sign.

LAND SUBSIDENCE COMPLICATES IRRIGATION

GEORGE Y. BLAIR, JR.

THE Firebaugh Canal Company serves approximately 23,000 acres of highly developed agricultural land within the Firebaugh Soil Conservation District in western Fresno County, California. The distribution facilities consist of three parallel lift canals, each approximately 13 miles in length. Water is brought by them from the Delta-Mendota Pool in central San Joaquin Valley.

These facilities were installed in 1925 and provided satisfactory service until 1951. In 1952, a problem of diminishing canal capacities became apparent. The problem increased in magnitude during subsequent years and became intolerable in the summer of 1959, for at that time it was impossible to maintain normal irrigation deliveries in the downstream reaches.

Consequently, the board of directors of the Firebaugh Canal Company retained a consulting engineering firm to determine the cause of this capacity problem and to recommend a solution. An investigation was immediately started. Comparisons of the U. S. Geological Survey topographical maps of 1928 with those made of the same area in 1956 indicated considerable land subsidence.

Land subsidence in the San Joaquin Valley has been a common occurrence in recent years. Two general types of land subsidence have been identified: (1) near surface subsidence, and (2) deep subsidence. Near surface subsidence is relatively local in extent and occurs in certain unusual soils when they are first irrigated. Deep subsidence, on the other hand, occurs over large areas and is a result of compaction of dewatered underground aquifers because of excessive pumping.

Comparison of the 1928 with the 1956 topographical maps indicated an area wide condition of deep subsidence. However, subsidence is normally not uniform throughout an area and consequently precise level surveys were conducted along the canals. The results of these surveys were as follows:

1 Land subsidence was not uniform over the entire area. It varied from nearly 3 to approximately 8 feet.

2 Over the first ten mile reach of the canals there existed a canal slope of approximately 1 foot. This slope was in contrast to the 1925 constructed slope of 6 feet.

3 A half-mile stretch was found to have a negative slope of approximately 0.5 feet.

Three alternate solutions to the problem became apparent: (1) Increase the operating head of the intake lift pumps and increase the canal sections by constructing levies, (2) line the canal sections, thereby providing better hydraulic characteristics so that higher water surface elevations in the downstream reaches could be maintained, or (3) install additional lift stations downstream in the canals.

The first alternative was eliminated, for by increasing the water surface elevation in the upstream reaches of the canals, an existing drainage problem in the surrounding land would be excessively aggravated. Alternative two was eliminated because of the relatively higher cost of construction and, also, because of the economic loss which would be suffered from future differential land subsidence.

Alternative three was selected as the most economical and flexible. By properly locating the lift station the water surface in the canal could be maintained at approximately the same elevation as when the canal was constructed. Also, with additional land subsidence, slight modifications in the lift stations would be all that would be required to maintain a satisfactory water surface elevation.

The type of lift station selected is somewhat unique when compared to the conventional irrigation lift station. Each lift station consists of two, low-head, propeller-type pumps of equal capacity. One pump operates at a constant speed. The second pump operates at variable speeds, providing adjustable flow over a range of 55 percent to 100 percent of the 90 cubic-feet-per-second maximum flow. The lift station structures (figure 1) are provided with automatic swinging gates to allow gravity flow through the stations for all conditions up to 50 percent maximum flow. The pumps are installed so that when they are not operating water flows through the pump columns as well as through the swinging gates. The result is a greater saving in power costs, in that the pumps are operated only when gravity flow will not supply downstream diversions at a satisfactory water surface elevation. In the event of future land subsidence, the gear reduction units driving the pumps will be changed to provide a higher operating speed and a net increase in the head that the pumps will develop. Thus, a satisfactory water surface elevation can be maintained.

(Author identification page 235)

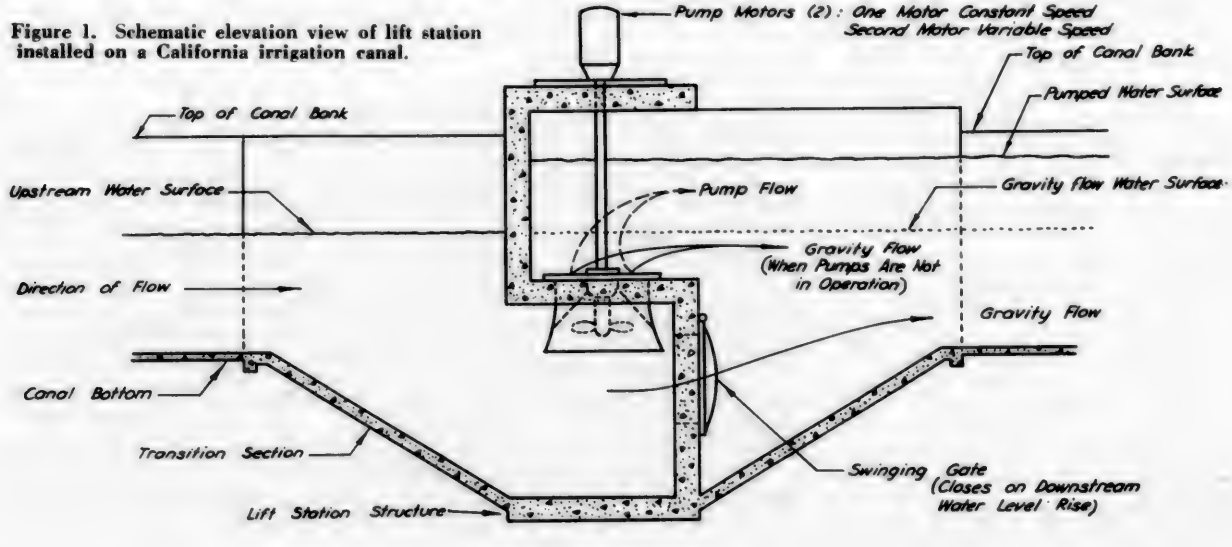


Figure 1. Schematic elevation view of lift station installed on a California irrigation canal.

New Mulching Machine

Necessity is the mother of invention. This often repeated phrase is the real reason Robert and Donald Wirth started building their new mulching machine. So far as they know there is no similar unit in use today.

In the fall of 1958, A. D. Wirth & Sons of Vesper, Kansas, were awarded a contract to seed floodwater retarding structures and waterway improvement work in the Little Delaware-Mission Creeks Watershed in Brown County, Kansas. The contract specified 2½ tons of good quality prairie hay per acre were to be distributed evenly over the entire seeded area.

At that time they had only a field chopper with which to do the required mulching. Hay was dumped along the edge of the area to be seeded and after windrowing the hay was blown onto the seeded area. That fall, with only 40 percent of their contract completed when cold weather set in, they decided to construct a machine that would do the job more efficiently.

A blower was mounted on a 2 wheel trailer and an auger installed to feed hay into it (figure 1). The machine is powered by the power take-off from their farm tractor. It is designed to carry 60 bales of hay on the platform, and can handle mulch at the rate of 2 bales per minute if the hay is in good condition. At this rate mulch can be applied to 1 acre every 36 minutes, or a waterway 1,000 feet long and 40 feet wide could be mulched in little over one-half hour. The machine requires a minimum of three men for operation, one to drive the tractor, one to feed the blower, and one to direct mulch placement by the blower.

Immediately following the mulching operation, mulch material should be anchored to reduce the hazards of wind and water erosion. The Wirth brothers used a weighted anchoring machine, featuring straight set serrated discs spaced 12 inches apart.

The author, Earnest A. Christie, is soil conservationist, Soil Conservation Service, Hiawatha, Kansas.

(See article on facing page)

George Y. Blair, Jr., is a partner in the consulting engineering firm of Blair-Westfall Associates in Fresno, California. This firm is engaged in flood control, drainage, and irrigation design.

This article is the text of a paper delivered by the author at a meeting of the San Joaquin Valley Section of the California Chapter, Soil Conservation Society of America.

Soil and Water Conservation Fairs in Oklahoma

Soil and water conservation fairs have been held every year in Grant County, Oklahoma for the past 6 years. This educational program was started by county agent J. D. Edmonson and work unit conservationist L. B. Bliss. Members of 4-H clubs and FFA chapters were invited to prepare conservation exhibits and enter soil judging contests. The supervisors of the Grant county Soil Conservation District agreed to provide plaques for the best exhibits and for winners on the soil judging contest. The idea gained momentum when the Chambers of Commerce in Medford and Pond Creek offered to provide a free evening meal for everyone who attended the fair.

The first fair was held in February 1955. Soil and water conservation exhibits were prepared by various agricultural agencies and a motion picture showing the importance of soil and water conservation in a successful wild life conservation program was provided by the Oklahoma Wild Life Commission.

A poster contest for 4-H club members and a grass and pasture plant identification contest were added to the program for the second fair. County bankers provided a cash award for the top ten placings in the poster contest and for first, second and third places in the grass and pasture plant identification contest.

A lecture on some phase of soil and water conservation has been presented each year as a part of the evening program. More than 400 people have attended the Grant county fair each year.

Soil and water conservation fairs were started in Kay County, Oklahoma in 1957. They were patterned in part after the Grant County program.

The first Kay County fair was a 1-day event and included a soil and water conservation poster contest open to any boy or girl in the county in the fourth through the twelfth grades. Various types of soil and water conservation exhibits were prepared by agricultural organizations and business people.

The second Kay County fair was expanded into a 2-day meeting. A land judging contest was added for adults and 4-H and FFA members. Also, a bread baking contest was included for home demonstration club members. Since wheat is a major crop in Kay County and bread is a major food, the program committee decided that a bread baking contest would create interest in soil conservation.

Team demonstrations on soil and water conservation by 4-H and FFA members and a livestock short course on pasture improvement and management were added to the third fair.

Approximately 850 people attended the first two Kay County fairs, and about 1,500 people attended the third fair. Persons enrolled in the land judging schools numbered 150, and 125 persons participated in the land judging contest. Agricultural implement dealers exhibited machinery used in soil and water conservation work at the last two fairs.

Agricultural workers in these two counties believe that the soil and water conservation fairs have created a greater interest among rural and urban people concerning the importance of conserving and improving the soil.

The author, Lee Stevens, is with the Agricultural Information Service, Oklahoma State University.

Figure 1. New mulching machine in process of spreading prairie hay mulch on a floodwater retarding structure that was recently seeded.

Soil Core Sampler for Substratum Investigations

ROME H. MICKELSON, FRED M. SANDOVAL, LEO C. BENZ, AND CARL W. CARLSON

SOIL INVESTIGATIONS frequently can be improved by more accurate methods for collecting materials below 5 feet. Important soil characteristics influencing drainage as well as important clues to soil genesis are frequently present just beyond the reach of conventional tools. This note describes a tool for obtaining relatively undisturbed cores of soil strata underlying the solum.

The sampler was developed and used in soil characterization studies in conjunction with drainage investigations in the Red River Valley in North Dakota. The sampler is attached to the auger shaft of a portable drilling rig which is mounted on a 4-wheel drive vehicle. It could be designed to fit any similar machine.

Procedure used was to drill a hole larger in diameter than the sampler, using a rotary action-type auger. When the desired depth was reached, the auger was replaced by the core sampler. The core was obtained by pushing the tool mechanically into the soil, utilizing the weight of the vehicle.

Figure 2 shows two views of a soil core. The tool obtains a core 2 $^{13}/_{16}$ inches in diameter and up to 9 inches in length. Specifications and dimensions are given in figure 3. Basic design is similar in principle to other soil sampling tools. Inside diameter of the cutting head is slightly smaller than the inside diameter of the main body. This permits a loosely held core which can be removed with relative ease on most soils penetrated. The slot on the back side allows pushing the core out of the sampler with minimum effort and disturbance. Construction is from 3-inch steel pipe and cold-rolled steel stock milled and threaded to fit the shaft of the drilling rig. Cutting head consists of a steel sleeve machined and welded inside the 3-inch pipe. The tool is rigid enough to withstand considerable force.

Soil cores were successfully collected from fine to medium textured lacustrine and glacial till materials. Best results were obtained on moist to saturated soils. Depths sampled were to 12 feet, the limit of the equipment used. The tool described was designed primarily to obtain cores for visual study. It was not designed to obtain a core of specific size or volume.

Rome H. Mickelson and Leo C. Benz are agricultural engineers, Fred M. Sandoval and Carl W. Carlson are soil scientists. All are with the Western Soil and Water Management Research Branch, Soil and Water Conservation Research Division, Agricultural Research Service, Grand Forks and Mandan, North Dakota.

Figure 1. Soil sampler mounted on drilling rig.

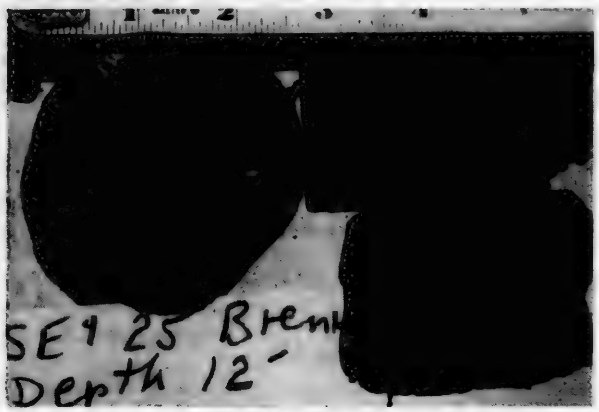
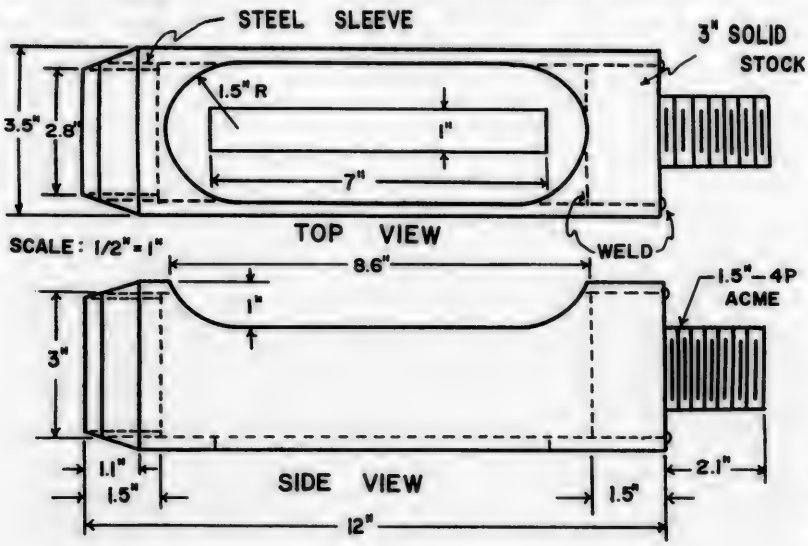


Figure 2. Vertical and horizontal views of a soil core. Note the iron concretions and light colored coatings on cleavage planes in soil of lacustrine origin. The right portion was split for better observation.

Figure 3. Specifications of the core sampler.



DATES TO REMEMBER

American Forestry Association Annual Meeting. October 1-4. Santa Fe, New Mexico.

Society of American Foresters Annual Meeting. October 8-11. Minneapolis. Minnesota.

Resources for Tomorrow Conference. October 22-28. Sponsored by the Canadian Government. Montreal, Canada.

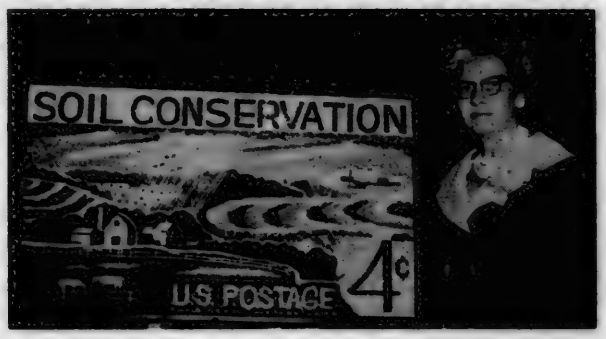
Southeastern Water Law Conference. November 8-10. University of Georgia. Athens, Georgia.

National Farm-City Week. November 17-23.

American Society of Agronomy Annual Meeting. November 27-30. St. Louis, Missouri.

American Association for the Advancement of Science, Section O (Agriculture). December 26-31. Denver, Colorado. "Land and Water Use" is the theme for the Section O Symposium. A general symposium under the title "Water and Climate" will also be held during the AAAS meeting.

For further information concerning any of these meetings please contact *Society* headquarters at 838 Fifth Avenue, Des Moines 14, Iowa.



(Left) A part of the registration line at the 16th annual Society meeting. Receiving his program (far right) is J. Harry Koller, farmer and Carroll County Soil Conservation District Supervisor from Maryland. (Right) Mrs. Ross Davies presented the Society a colored mosaic replica of the soil conservation commemorative stamp at the 16th annual meeting. This work of art was painstakingly constructed of glass chips by Mrs. Davies and her daughter. The late Mr. Davies was state conservationist for the Soil Conservation Service in South Dakota and was chairman of the local arrangements committee for the 14th annual Society meeting at the time of his death. A feature of the 14th annual meeting, held in Rapid City, was the first day release of this postage stamp.

(Continued from page 202)

publish annual meeting proceedings and to develop a cooperative program with other conservation organizations.

All officers and Council members, as well as thirty committee chairmen, submitted reports that were considered by the Council. Many were progress reports and members will be informed at a future date of the action taken. Items on which specific action was taken follow: (Members desiring more information on any of the points listed are urged to write to the Executive Secretary.)

1 Approved the final working drawings and agreed to proceed with letting the contract for the *Society's* headquarters building within 60 days after the meeting, contingent upon receipt of an additional $10,000 to $20,000.

The Executive Committee was delegated to make the necessary contractual obligations and decisions with regard to the building program.

2 Appointed a special committee to study and advise members of the *Society* on Memorial gifts or major contributions for the *Society's* new headquarters building and to determine a way to properly recognize such donors.

3 Approved the recommendation of Editor Jeske to establish a new format for the cover of the JOURNAL OF SOIL AND WATER CONSERVATION and to adopt a three column page for major articles, these changes to take place with the first issue of Volume 17.

4 Made preliminary plans for a member photography contest to acquire good, original pictures for the JOURNAL OF SOIL AND WATER CONSERVATION, promote conservation and secure publicity through display of the photographs.

5 "Conservation—A Key to World Progress" was selected as the revised theme for the 1962 annual meeting to be held in Washington, D.C., August 26-29, 1962.

6 Nominated N. R. Richards and Walter C. Gumbel to represent the *Soil Conservation Society of America* at the Canadian "Resources For Tomorrow" conference to be held in Montreal, October 23-26, 1961.

7 Made preliminary plans for the sponsorship of a national conference on soil and water conservation, with emphasis also on related resources; this conference would be conducted in workshop form for industry people who have originated the suggestion.

8 Authorized the Mined Area Restoration Committee to proceed with their recommendation to sponsor a workshop meeting of technical people representing all aspects and interests involved in the complicated and variable conditions of mined area restoration.

9 Voted to have the *Society* continue as a sponsor of the National Watershed Congress. The ninth Congress will be held in Columbus, Ohio, May 7-9, 1962.

10 Accepted the Elections Committee report indicating the election of R. D. Hockensmith, Washington, D.C., as President for 1962; George M. Browning, Ames, Iowa, as First Vice President; Herbert A. Hopper, Lafayette, California, as Second Vice President; Howard F. Barrows, St. Augustine, Florida, Treasurer; Cecil W. Chapman, Athens, Georgia, Council Member-at-Large; John R. J. Bradshaw, Salt Lake City, Utah, Western Region Council Member; Herbert Crown, Toronto, Ontario, Canadian Region Council Member. (Complete details about officials elected will be carried in the November issue of the JOURNAL.)

11 Authorized the Special Publications Committee to proceed with a revision of the booklet "Story of Land" for introduction in the fall of 1962; and also to start production on a new publication on total land use involving agriculture, water, wildlife, etc. This booklet is to replace the original and first popular publication of the *Society*, "Down the River."

12 Established an additional technical study committe in the area of conservation economics.

13 Confirmed prior action providing for a reduction of dues to one-half the regular rate for retired members who request this privilege. This is to become effective for 1962 dues payable for those having continuous membership during the previous 4 years. This action will be called to the attention of chapters and they will also be encouraged to use retired members in assisting with chapter programs, help them search for jobs for which they are qualified, etc.

14 Established August 25-28 as the dates for the 1963 annual meeting at Logan, Utah; and August 23-26 for the 1964 annual meeting in Jackson, Mississippi.

15 Revised the policies and procedures under which the *Society* carries on its day to day activities, including a limitation of $10,000 in each federally insured depositary in which building funds are maintained.

This has been only a brief resumé of important actions taken, of studies under way by committees, and of the *Society's* total influence. You can only fully benefit if you are an active member. Plan now to participate in the 1962 annual meeting.

—H. WAYNE PRITCHARD

In recognition of his 10 years of loyal and distinguished service as Executive Secretary of the Society, H. Wayne Pritchard (left) was presented a certificate by Society president, Walter Gumbel. The handsome award carried the signatures of the living past presidents of the Society under whom Pritchard has served.

Annual Meeting—Personalities and Progress

(Left) Harry Galloway receives from Walter Gumbel a President's Citation in recognition of his excellent work as chairman of the Local Arrangements Committee. (Right) Frank Mendell, efficient and effective chairman of the Program Committee.

W. O. Lambeth, North Carolina Chapter Chairman, receives on behalf of his chapter the Sweepstakes Banner in the *Society's* single outstanding chapter activities contest. President Gumbel is on the right.

ANNUAL SOCIETY AUDIT COMPLETED

The strong activities program of the *Soil Conservation Society of America* has brought about increased financial transactions during the fiscal year closed on June 30, 1961.

Howard F. Barrows, Treasurer and Minott Silliman, Jr., chairman of the Finance Committee, have stated that the finances of the *Society* are basically in good condition.

The books of the *Society* are audited by the firm of Peat, Marwick, Mitchell & Co., with offices in the Hubbell Building, Des Moines, Iowa.

The following statement of the *Society's* financial condition was extracted from the report of the auditing firm. Comparative figures from the previous year's report are given.

Soil Conservation Society of America Incorporated

Statement of Financial Condition June 30, 1961

ASSETS

Current assets:	1961	1960
Cash	$ 27,585.05	$ 23,371.89
Acc'ts. rec.	8,234.66	1,269.20
Inventory	3,683.10	2,900.11
Adv. payment		2,000.00
Prepaid expenses:		
Office supplies	4,197.74	2,059.67
Pension tr. agr.	369.35	1,126.14
Unexpired ins.	279.25	240.95
Total current assets	$ 44,349.15	$ 32,967.96
Building fund	37,856.06	10,429.64
Sustaining mbr. fund		3,870.00
Equip. repl. fund	1,080.00	580.00
Development fund	640.44	502.94
Treasury bonds[1]	12,972.53	14,959.09
Office equipment	5,298.88	5,901.82
Airline deposit	425.00	425.00
Total assets	$102,622.06	$ 69,636.45

[1] Treasury Bonds cashed during year were deposited in savings account and included in "cash."

The increased assets of the *Society* were accounted for by the growth of the *Society* Building Fund during 1961.

It is significant that the *Society* spent $1,784.71 for promotion of the new building project from the operating account during the year. This was not charged to the funds received for the building although the total income for the building up to June 30, 1961, was $39,468.56 of which $1,612.50 had been spent for well boring and architectural fees. This left the balance of $37,856.06 as reported under assets.

LIABILITIES

Current liabilities:	1961	1960
Accounts payable	$ 2,452.62	$ 922.82
Commissions payable	524.44	1,019.10
Withholding tax		258.55
Chap. dues refundable	84.50	161.00
Due other funds	2,875.48	313.05
Accrued taxes		109.41
Total current liabilities	$ 5,937.04	$ 2,783.93
Deferred mbr. dues	32,218.88	24,084.16
Membership equity: (restricted)		
Building fund	37,856.06	10,429.64
Sustaining mbr. fund		3,870.00
Equip. repl. fund	1,080.00	580.00
Development fund	640.44	502.94
Total restricted equity	39,576.50	15,382.58
Unrestricted equity	24,889.64	27,385.78
Total member equity	64,466.14	42,768.36
Total liabilities	$102,622.06	$ 69,636.45

A complete report of the accounting for the past year would prove too lengthy for reproduction here but an abstracted statement of income and expenses would be as follows:

Income:	1961	1960
Membership	$54,795.58	$42,290.94
Journal	10,073.18	11,758.58
Booklet profit	7,359.88	12,178.22
Chapter supplies	1,443.98	1,071.53
Annual meeting	−379.83	1,071.22
Total operating income	$73,292.79	$68,370.49
Expenses:		
International office	$41,137.60	$40,305.38
Journal	28,672.21	26,130.10
Other	6,563.90	4,640.51
Total operating expenses	$76,373.71	$71,075.99
Operating loss	3,080.92	2,705.50
Interest & Misc	1,084.78	761.70
Net loss	$ 1,996.14	$ 1,943.80

During the year the *Society* completed arrangements for registration of the title of both the organization and the JOURNAL with expenses amounting to $351.88. This is a "one time" expense item.

Council expenses increased by $626.91, attributed largely to the increased activity and necessity for an Executive Committee meeting in conjunction with the building program.

The items mentioned in this explanation accounted for the small operation deficit for the fiscal year 1960-61.

Members desiring more information about the financial structure of the *Society* or about the transactions for the fiscal year may secure this by writing to the Treasurer or the Executive Secretary.

CHAPTER AWARDS

The Chapter Activities contest is designed to recognize those chapters that develop and carry out significant and far reaching programs promoting Society objectives. To stimulate and encourage other chapters, accounts of outstanding chapter programs and activities are published.

There are two classes in the contest—a single outstanding chapter activity, and the total chapter program. Any SCSA Chapter may enter either class, but no chapter may enter both classes. Award winners in 1961 presented with appropriate banners at the sixteenth annual meeting included:

Sweepstakes, single outstanding chapter activity, **North Carolina Chapter** (Southeast Region), W. O. Lambeth, chairman.

Sweepstakes, total chapter program, **Northern Illinois Chapter** (North Central Region), Ray Lane, chairman.

Student Chapter, total chapter program, **California State Polytechnic College Student Chapter,** San Luis Obispo, Logan Carter, advisor.

Regional winners in the single outstanding chapter activity contest included the Virginia Chapter (Northeast), William E. Cooper, chairman; Minnesota Chapter (North Central), M. A. Thorfinnson, chairman; Manhattan Chapter (Great Plains), Merton Otto, chairman.

Total chapter program winners on the regional level were West Virginia Chapter (Northeast), John Myers, chairman; East Tennessee Chapter (Southeast), Joe Spencer, chairman; California Chapter (Western), Clark Gleason, chairman.

Named by the judges of the contest as worthy of honorable mention in the Student Chapter contest was the Rutgers University Student Chapter, Robert Hanna, advisor.

(Left) Dr. Jamie Bague, Santurce, Puerto Rico, one of the men who translated the Glossary of Soil and Water Conservation into Spanish, receives a President's Citation from President Gumbel. (Right) The delegation from Kansas at the 16th annual meeting.

(Left) Hoosier Chapter members were superb hosts. Not only was the food at the huge chicken barbecue a gourmet's delight, but the rapidity with which it served was amazing. (Right) Mrs. America of 1961, Mrs. Rosemary Murphy of Kentland, Indiana, posed with C. E. Swain after giving her talk at the barbecue.

(Left) An example of the numerous educational exhibits displayed at the annual meeting. (Right) Immediately after his presentation to SCSA members and guests, Secretary of Agriculture Freeman held a press conference.

(Top left) The food was splendid! Firman E. Bear, Mrs. Gumbel, Walter Gumbel, President-elect Roy Hockensmith, Mrs. Hockensmith, and Mrs. Bear. (Lower left) East Tennessee Chapter delegation. (Right) To these men goes the credit for excellent annual meeting photographic coverage. (Left to right—kneeling) Jim Buttke and Gene Leedy. (Standing) Jim Acres and Marion "Shorty" Merritt.

Herbert A. Flueck

Robert M. Hanna

Maurice E. Heath

Frank F. Morwick

Irving B. Stafford

Fellows—1961

The Soil Conservation Society of America annually elects to the Degree of Fellow, individuals who have made significant contributions to advance the science and art of good land use. This recognition goes to members professionally engaged in practicing, investigating, administering or teaching soil and water conservation.

Herbert A. Flueck, *St. Paul, Minnesota,* state conservationist, Soil Conservation Service.

Since 1937, Flueck has rendered exceptional service in his present position. He joined the Soil Conservation Service in 1933 just as work was getting underway at Coon Valley, Wisconsin, on the first erosion control demonstration project in the United States. After the successful initiation of this project he was put in charge of soil conservation field work in Minnesota where he directed several demonstration projects and supervised the work of 10 CCC camps.

He was instrumental in persuading the Minnesota Legislature to pass the Soil Conservation District Law in 1937 and has continuously promoted the watershed approach to solution of soil and water conservation problems.

Flueck, a charter member of the *Society,* has always actively encouraged others to join. He was one of the organizers of the Minnesota Chapter, *SCSA,* and in 1959 he served on the parent *Society's* nominating committee.

Robert M. Hanna, *New Brunswick, New Jersey,* associate extension specialist in soils, Rutgers—the State University.

Hanna, a native of Louisiana, received his M.S. degree in agronomy at Kansas State College where he specialized in soil science. In 1954, he was named assistant soil scientist in research at the Connecticut Agricultural Experiment Station and in 1957 was elected to his present position.

He has worked cooperatively with numerous conservation groups in New Jersey and has carried out a variety of soil conservation demonstrations on the uplands and in the orchards of the state. He has been active in wildlife conservation and in stimulating industry efforts in wind erosion control.

Hanna's service on the education committee of the New Jersey Chapter led to his appointment as faculty advisor to the Student Chapter of *SCSA* at Rutgers and thence to his being named chairman of the *Society's* national Student Chapter Committee. He is the author of several articles published in professional journals and is currently serving his second term as chairman of the New Jersey Chapter.

Maurice E. Heath, *Lafayette, Indiana,* associate professor of agronomy, Purdue University.

Born and raised in Iowa, Heath graduated from the Iowa State University, and in 1939 began 10 years of service as associate agronomist with the U. S. Department of Agriculture Cooperative Research with state experiment stations in Iowa, Minnesota, and Illinois. He then served with the Soil Conservation Service as management agronomist for the 12 northeastern states. He operated a beef, forage, and seed farm in Florida for 2 years and then spent 1 year in Iran with the Technical Cooperation Administration prior to joining the staff at Purdue University in 1953.

Heath has been a frequent contributor to several professional-technical publications, including the JOURNAL OF SOIL AND WATER CONSERVATION. The co-author of the textbook *Forage—the Science of Grassland Agriculture,* he was cited in 1949 by the USDA for "outstanding service to agriculture through his assistance in finding and developing vegetative controls in soil conservation."

An active member of the Hoosier Chapter, Heath has appeared on previous *Society* annual meeting programs and is currently serving on a committee for the 1961 conference.

Frank F. Morwick, *Guelph, Ontario, Canada,* professor, Department of Soils, Ontario Agricultural College.

In 1928, Morwick received one of the first Master's degrees granted at the Ontario Agricultural College by the University of Toronto. Upon graduation he was appointed as Supervisor of Soil Surveys for the Province of Ontario and in that capacity he worked diligently to correlate the efforts of the United States and Canadian soil survey staffs.

Morwick has been actively engaged in soil research, soil survey, and glacial geology studies for more than a quarter century and his work has had a profound influence on soil conservation over a wide area.

He has served as chairman of the Ontario Chapter, *SCSA,* and was active in making arrangements for the annual meeting of the *Society* held in Canada last year. He is a Fellow of the Chemical Institute of Canada and has been provincial director of the Agricultural Institute of Canada as well as chairman of the Canadian Soil Science Society.

Irving B. Stafford, *Syracuse, New York,* state conservationist, Soil Conservation Service.

A native of Massachusetts, Stafford received his M.S. degree in horticulture from Syracuse University in 1923 and served on the faculty of the College of Agriculture there until 1935. Named as assistant agronomist for the staff of the Soil Conservation Service in New York, he later served in the regional office of that agency at Upper Darby, Pennsylvania.

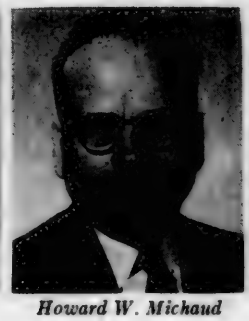
Since 1941, Stafford has served in his present position and has exhibited exceptional leadership in developing a sound, well-balanced soil and water conservation program. He was instrumental in forming the New York State Association of Soil Conservation Districts and during his tenure as state conservationist 46 new soil conservation districts have been formed. His counsel and guidance have influenced much of the new water legislation in the state.

Stafford, a charter member of the *Society,* has attended every annual meeting and his long record of service to the *Society* has included membership on five different *SCSA* committees. In 1946 he was a leader in organizing the Empire State chapter.

Donald Anderson

Herman E. Baggenstoss

Clair P. Guess, Jr.


Howard W. Michaud

Matthias A. Thorfinnson

Honorary Members

Each year the Soil Conservation Society of America selects Honorary Members. This honor is conferred on individuals on the basis of superior contributions to soil and water conservation without regard to profession, occupation, or membership in the Society.

Donald Anderson, *Honey Creek, Iowa,* farmer.

A native Iowan, Anderson now operates a 628 acre farm in the southwestern part of the state. He was a leader in organizing the West Pottawattamie Soil Conservation District in 1944 and has served continuously since that time as a district commissioner or associate commissioner.

Active in the organization of the Southwest Iowa Association of District Commissioners, he later served as president of the Iowa Association for 2 years. He served for 3 years on the Board of Directors of the National Association of Soil Conservation Districts and as an area vice president of that organization in 1952. He has made outstanding contributions to the organization and development of soil and water conservation districts in the Cornbelt states.

Anderson received the Recognition Award for Outstanding Contributions to Soil and Water Conservation given by the Iowa Farm and Home Register in 1950. An active member of the Iowa Chapter of the *Society*, he has appeared on the chapter's annual meeting program several times during recent years.

Herman E. Baggenstoss, *Tracy City, Tennessee,* publisher, tree farmer, and president of the Forest Farmers Association.

One of the real champions of soil conservation in the Southeast, Baggenstoss is the publisher and editor of the *Grundy County Herald* as well as a certified tree farmer.

Baggenstoss' promotion of natural resources conservation and management projects has profoundly influenced Tennessee natural resource development over the past quarter century. In 1935, he helped draft a model fish and game law for Tennessee and shortly thereafter helped found the Tennessee Federation of Sportsmen. He served as president of that organization's successor, the Tennessee Wildlife Federation, and while associated with the Federation he originated the *Tennessee Wildlife Magazine*, a forerunner of the present day *Tennessee Conservationist.*

Inspired by Baggenstoss, the Tennessee Forest Festival promotion, initiated by him in Tracy City in 1949, will this year attract over 50,000 people to its educational exhibits and demonstrations. Baggenstoss is an active member of the East Tennessee Chapter *SCSA.*

Clair P. Guess, Jr., *League City, Texas,* manager of the service department, National Association of Soil Conservation Districts.

Born on a southern cotton plantation near Denmark, South Carolina, Guess received his B.S. degree in agricultural engineering from Clemson College.

Upon discharge from the U. S. Navy in 1946, Guess operated a farm and dairy in South Carolina. He served as supervisor of the Edisto Soil Conservation District from 1947 to 1954 and as president of the South Carolina Association of Soil Conservation District Supervisors for a year.

After serving as executive secretary of the South Carolina State Soil Conservation Committee from 1951 to 1956, he was employed by NASCD as program advisor until 1959 when he was named to his present position. The influence Guess has exerted in the conservation movement has extended far beyond the limits of his community for he has personally visited and studied soil conservation districts in operation in 45 of the 50 states and his counsel and guidance relative to solution of district problems is highly valued.

Howard W. Michaud, *Lafayette, Indiana,* professor of conservation, Purdue University.

Michaud, the recognized leader of conservation education in Indiana, was a teacher of biology in the public schools of the state for some 20 years prior to joining the faculty at Purdue University in 1945. In addition to his teaching responsibilities at the University, he has served for the past 14 years as director of the annual, 6-week Conservation Education Camp. Over the years a large number of teachers, administrators and conservation leaders have been trained at this camp for teaching conservation of natural resources in their local communities.

The author of numerous articles published in various scientific journals, Michaud is currently in charge of a junior science program in which he works with science teachers and high school students throughout the state. He has just completed a "teacher's guide" for use with the film "Soil Conservation," now in preparation by the Coronet Film Company.

Michaud has been president of the National Association of Biology Teachers, the Indiana Audubon Society, the Indiana Division of the Izaak Walton League of America, and is a Fellow of the Indiana Academy of Science.

Matthias A. Thorfinnson, *St. Paul, Minnesota,* executive secretary, State Soil Conservation Committee.

One of the pioneers of the soil conservation movement, Thorfinnson has with singular devotion worked to improve and develop conservation programs in Minnesota and throughout the Midwest. Upon graduation from North Dakota Agricultural College in 1917 he served for 7 years as a county agent in Montana.

Returning to Minnesota in 1924, he was a county agent until 1936 when he was named as extension soil conservationist by the Minnesota Extension Service. The Minnesota State Soil Conservation Committee was organized a year later and he became this group's executive secretary, a position he has filled with distinction and honor to the present time. In 1955 he retired from the Extension Service.

Thorfinnson was instrumental in organizing the first Midwest Conservation Education Conference, held in Wisconsin in 1950 and devoted to developing methods for more effective conservation teaching. In 1955, he provided leadership in organizing the Minnesota Conservation Education Council. A true leader in soil and water conservation, Thorfinnson has been a long time member of the *Society* and this year is chairman of the Minnesota Chapter, *SCSA.*

President's Citations and Commendation Awards—1961

CITATIONS

Each year many individuals contribute immeasurable time, talent and treasure to further the objectives of the Soil Conservation Society of America. It is not possible to recognize the many persons who make the Society a vital force in conserving natural resources. Therefore, it is the desire of the president to point out individuals who have made a singular contribution "to advance the science and art of good land use" and express his appreciation for their endeavors.

The nine individuals receiving the President's Citation at the sixteenth annual meeting included:

Jamie Bague, *Santurce, Puerto Rico.* His superior efforts in assisting with the translation of the *Society's* "Glossary of Soil and Water Conservation" into Spanish is a project that will advance the work of the *Society* in many areas of the world.

William M. Briggs, *Lafayette, Indiana.* As chairman of the *Society's* Membership Committee, he has established a successful membership development program. His effective work with a large committee is noteworthy and his devotion to the entire *SCSA* program is worthy of emulation.

Albert B. Foster, *Washington, D. C.* His excellent work in preparing copy for the *Society's* newest popular type educational booklet, "Help Keep Our Land Beautiful," has resulted in wide acceptance of this practical educational tool.

Harry M. Galloway, *Lafayette, Indiana.* As chairman of the Annual Meeting Local Arrangements Committee he has efficiently organized and given excellent leadership to plans for the sixteenth annual *Society* meeting. The result of his efforts has been a smoothly operating convention.

William H. Gracia, *San Juan, Puerto Rico.* His work as chairman of the *Society* committee charged with translating the "Glossary of Soil and Water Conservation" into Spanish will be of lasting value to conservation efforts in all Spanish speaking countries.

Frank H. Mendell, *Des Moines, Iowa.* As chairman of the Annual Meeting Program Committee and as chairman of the *Society's* Housing Committee, he has given particularly noteworthy leadership. He has served the cause of conservation and the *Society* with honor to himself and reflected distinction to the *SCSA*.

Pauline A. Skinner, *Des Moines, Iowa.* Her superior work, dedicated service and devotion to the *Soil Conservation Society of America* as a member of the headquarters staff for the past 10 years has resulted in efficient and prompt service to all members of the *Society*.

Elmer L. Smith, *Peoria, Illinois.* His work in securing the active support and cooperation of industrial firms for soil conservation and watershed programs has effectively furthered the science and art of good land use. His counsel and guidance are highly valued by *Society* members and his dedicated service to the Northern Illinois chapter is outstanding.

James K. Vessey, *Atlanta, Georgia.* His superior service as a past member of the Council of the *Society*, willingness to assist with special committee assignments at any time, and his outstanding public relations efforts in behalf of natural resource conservation and the *Society* are meritorious.

COMMENDATIONS

Within local, state or regional boundaries a great number of individuals perform exceptional service in behalf of the Society. The Commendation certificate is presented to individuals, nominated by a chapter or Council member, for superior contributions in advancing soil and water conservation. The Awards Committee reviews all nominations.

A handsome certificate bearing the reason for the commendation is presented the recipient. The nine individuals receiving the Commendation certificate at the sixteenth annual meeting included:

Wayne W. Austin, *Orinda, California*

Jackson Bennett, *Athens, Georgia*

John R. J. Bradshaw, *Bountiful, Utah*

Wayne Kessler, *Phoenix, Arizona*

Glenn Lorang, *Spokane, Washington*

Raymond T. Lynge, *Urbana, Illinois*

Theodore A. Neubauer, *Arlington, Virginia*

Douglas Stewart, *Salt Lake City, Utah*

E. V. Wickline, *Lewisburg, West Virginia*

Building Fund

AN HONOR ROLL of those chapters that have already paid their proportionate share toward the cost of the *Society's* new headquarters building has been set up. The proportionate share is based on building fund receipts of $10 per member, using the July 1, 1961, chapter membership roster. These Honor Roll chapters continue to work diligently to exceed their already fine performance:

Central Arkansas
Ozark Mountain (Arkansas)
Iowa
New Jersey
William Penn (Pennsylvania)
Heart of Texas

THE ARCHITECT has released specifications for the *Society's* new home. Contractors will have until October 12 to return their bids; within 30 days the *Society* must accept or reject them. Whether or not a contract can be awarded if an acceptable bid is received will be determined by the immediate action of several chapters, for the Council has determined that $60,000 to $70,000 must be on deposit in the Building Fund before a contract can be awarded. NOW is the time for ACTION!

OTHERS HAVE DEMONSTRATED their interest and faith in the *Society* by contributing toward construction costs. The International Harvester Company and John Deere and Company have given substantial monetary help. The wood industries will give the wood paneling needed and a brick and tile firm has indicated an interest in donating the bricks necessary for building construction.

Journal Awards

The selection of outstanding articles published in the JOURNAL OF SOIL AND WATER CONSERVATION *is made by Society member nominations directed to the Editorial Board. Eligible for awards this year were articles originally published in the* JOURNAL *between July 1, 1958 and June 30, 1961.*

The JOURNAL *article "Subsoiling Seldom Pays in the Midwest" was named as the 1961 award winner. This article appeared in Volume 15, Number 6, the November 1960 issue. Each of the three co-authors was presented with a certificate inscribed as follows:*

"This certificate of Merit is awarded to **V. C. Jamison, W. E. Larson** and **W. G. Lovely** for the superior article "Subsoiling Seldom Pays in the Midwest" which assembled and summarized scattered research data on a practice of wide interest to farmers and soil conservationists."

SOCIETY BUILDING FUND REPORT—AUGUST 31, 1961

Chapter	Chapter Pledge	Paid to Date	Other Evidence of Support
Great Plains Region			
El Paso County *(Colo.)*	$ 250	380.00	
Ark. River Bend *(Kans.)*	320	184.60	(1)
Bluestem Hills *(Kans.)*		31.00	
Bob White *(Kans.)*	145	20.00	(1)
Fort Hays *(Kans.)*		22.00	(1)
High Plains *(Kans.)*		51.65	
Manhattan *(Kans.)*	1,000	408.00	(1)
Pony Express *(Kans.)*		164.39	(1)
Salina *(Kans.)*		170.50	(1)
Santa Fe Trail *(Kans.)*		11.00	
Southwest Kansas		19.00	
Bozeman *(Mont.)*		84.00	
Blue-Nemaha *(Nebr.)*		10.00	(1)
Lincoln *(Nebr.)*		192.50	(1)
Northeast Nebraska		43.50	(1)
Panhandle *(Nebr.)*			(1)
S. C. Nebraska		237.03	(1)
Southwest Nebraska		19.65	
Rio Grande *(N. Mex.)*	75	202.00	
Custer *(N. Dak.)*		229.63	
Big Hunt *(Okla.)*		22.25	
Central Oklahoma		35.00	
E. C. Oklahoma		102.25	
N. E. Oklahoma		179.32	
Northwest Oklahoma		4.00	
S. C. Oklahoma	100	68.00	
Southeast Oklahoma		13.50	
Southwest Oklahoma		152.00	
Stillwater *(Okla.)*		55.50	(1)
South Dakota		1,219.25	
East Texas	442	265.50	(1)
Heart of Texas		737.41	(1)
North Texas	50	267.50	(1)
N. C. Texas	50		
Wyoming		96.00	
TOTAL—Great Plains Region		$5,697.93	
North Central Region			
Egyptian *(Ill.)*	250	88.00	(1)
Northern Illinois	2,600	786.70	(1)
Hoosier *(Ind.)*		1,440.75	(1)
Iowa	5,000	4,526.30	(1)
Hugh Bennett *(Ky.)*		60.00	(1)
Blue Grass *(Ky.)*		193.00	(1)
Green River *(Ky.)*		50.00	(1)
Kentucky Lake	250	175.50	(1)
Lake Cumberland *(Ky.)*		35.00	
Limestone *(Ky.)*		10.00	
Northern Kentucky		40.00	
Upper Kentucky River *(Ky.)*		40.00	
Michigan	2,500	838.42	(1)
Minnesota	1,600	641.25	(1)
Show-Me *(Mo.)*		257.00	
All Ohio	1,000	557.00	(1)
Wisconsin	2,400	615.50	(1)
TOTAL—North Central Region		$10,354.42	
Northeastern Region			
S. New England *(Conn.-Mass.-R. I.)*		74.00	
Washington, D. C.	5,000	2,554.92	(1)
N. New England *(Maine-N. H.-Vt.)*	1,480	142.50	(1)
Old Line *(Md.)*	1,500	574.00	(1)
Pocomoke *(Md.)*		100.00	(1)
New Jersey	1,250	1,434.00	(1)
Empire State *(N. Y.)*	2,000	1,360.58	(1)
Keystone *(Pa.)*	1,000	262.50	(1)
Wm. Penn *(Pa.-Del.)*	400	543.50	(1)
Virginia	2,500	968.25	(1)
West Virginia	3,000	3,000.00	(1)
TOTAL—Northeastern Region		$11,014.25	
Southeastern Region			
North Alabama		25.00	
South Alabama		193.50	
Central Arkansas	800	903.00	(1)
Ozark Mt. *(Ark.)*		309.00	
Florida	890	367.00	
Georgia	5,000	760.00	(1)
Louisiana		170.00	
Mississippi	1,000	68.50	(1)
North Carolina	5,000	742.25	(1)
San Juan *(P.R.)*	500	142.00	
Western Puerto Rico		20.50	
South Carolina	795	565.55	
Andrew Jackson *(Tenn.)*	1,000	599.00	(1)
East Tennessee	900	129.50	(1)
West Tennessee	570	242.75	(1)
TOTAL—Southeastern Region		$5,237.55	
Western Region			
Arizona		111.00	(1)
California	3,500	1,815.75	(1)
R. N. Irving *(Idaho)*		140.50	(1)
Nevada		27.00	
Oregon		110.50	(1)
Utah		153.50	(1)
Inland Empire *(Wash.-Idaho)*		192.50	
Olympic View *(Wash.)*		31.50	(1)
TOTAL—Western Region		$2,582.25	
Canadian Region			
Ontario	1,600	1,340.00	
Other Contributions			
Korea		20.00	(1)
No Chapter Designated		571.50	
Development Fund Board Special Solicitation[1]		3,092.50	
Des Moines Fund Drive[1]		6,995.00	
Transfer of Funds		3,870.00	
Total	$57,217	$50,775.40	51
Interest earned		$ 644.74	
Total on deposit		$51,420.14	
GRAND TOTAL ([1]additional $3,000 to be paid upon letting of contract)		**$54,420.14**	

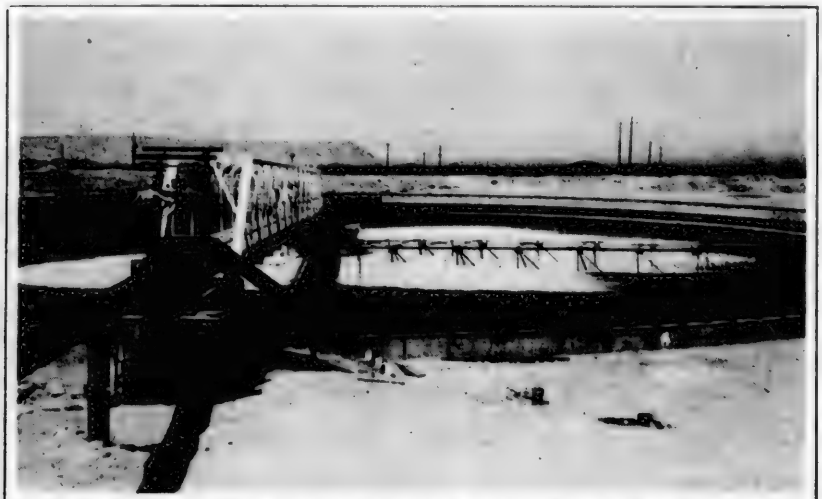
(1) Chapter Building Fund Committee Organized

CHAPTER NEWS

Michigan Chapter recently sent to the *Society's* home office a check for the amount that the chapter had earned as commissions on the sale of *Society* publications; this is to be applied to the *Society's* Building Fund. The chapter has indicated that all future commissions earned from the sale of publications will be earmarked for the Building Fund.

Show-Me Chapter (Missouri) enjoyed their annual picnic this year at the Lake of the Ozarks State Park. Plans have been made to aim for area meetings in the State rather than several statewide meetings.

Utah Chapter members toured the Weber Basin Project near Ogden on July 21 as a part of their Summer Outing program.



Milky-looking SS-13 spread out in tailing thickener pond of new Arizona copper mine. Pond holds 3,500,000 gallons of water. Before treatment pond lost nearly 53% of its contents per 24-hour day through seepage. After treatment daily loss dropped to 4% of contents per day.

SS-13 SLOWS SEEPAGE 92%

SOIL SEALER-13 SCORES SUCCESS IN FIRST MINING POND APPLICATION

Last July the 3,500,000-gallon tailing thickener pond of the new copper mine in Arizona* was a real problem. It was losing water through seepage at the rate of 1285 gallons a minute. The sides of the tank are concrete and the bottom is of compacted native soil.

The company decided to treat with SS-13. Less than 30 minutes after the SS-13 tank truck rolled up to the pond the job was done. Seventy-two hours later water seepage had dropped to 100 gallons per minute . . . a reduction in water loss of 92%. On a square foot of wetted area basis pre-treatment loss had been a steady 3.5 cubic feet per day per square foot as against a post-treatment loss of just 0.3 cubic feet per day.

SS-13 is a liquid compound of resinous polymers and heavy atoms carried in a small proportion of common diesel fuel. It is miscible with water. It is harmless to animals, but, when in solution, is harmful to fish.

FOR ADDITIONAL INFORMATION AND EXPERIENCE DATA FILL OUT AND MAIL THE COUPON BELOW.

**Its name and location will be furnished on request.*

SS-13

SALES COMPANY

P.O. BOX 4425 • PHOENIX, ARIZONA

Please send me more data concerning Soil Sealer-13 with special reference to its use in.....

.....

Name .....

Address .....

City..... *State* .....

Tennessee Chapters report that 190 members and guests attended the first annual convention of *SCSA* in Tennessee. "Resource Conservation and Use in 1975 and Beyond" was the theme of this most successful meeting. As the featured banquet speaker, Herbert Eagon, director of the Department of Natural Resources for Ohio, outlined reasons why the watershed approach is the natural and logical method of insuring maximum effectiveness of future conservation efforts.

Northern New England Chapter (Maine, New Hampshire, Vermont) held its annual meeting May 19 and 20 at Portsmouth, N. H. After review by the chapter's editorial committee, 14 excellent papers were presented. David Allan's paper, "Field Testing of Granular 2,4-D in Aquatic Plant Control" was judged the best paper presented.

A bus tour of agricultural and historical points of interest in Stafford and Rockingham Soil Conservation Districts was a meeting highlight. At one stop on the tour, Floyd V. Barker arranged for a demonstration of pumping water from a "dry hydrant" in a farm pond. His paper on this subject will appear in a future issue of the JOURNAL. The chapter's award for the best conservation display at the meeting was given Robert S. Palmer.

Northern Illinois Chapter—A successful conservation demonstration has been set up by the Land Improvement Committee of the chapter. Since the spring of 1959, on Kankakee State Park land and on additional adjacent acreage owned by the Northern Illinois Public Service Company, the committee has built a farm pond, stocked it with fish, planted 6,000 pine seedlings on 6 acres, set out on the contour a 5,000 plant multiflora rose hedge, planted 2 acres to wildlife cover using 20 species of adapted trees and shrubs, seeded a plot to 30 varieties of wild and domestic grasses and legumes, and constructed diversion terraces and grass waterways. In addition to all this there is an area of unpastured native hardwoods.

Because the conservation demonstration area is located in a State Park, many youth groups as well as adults have the opportunity to see it, and large numbers of groups from schools and colleges, as well as groups from South Chicago, only 50 miles distant, tour the site. The Kankakee Soil Conservation District uses the demonstration area as a tour stop. Located nearby is a 4-H camp to which more than 2,500 youngsters come each year; these boys and girls use the area for nature study classes.

SOIL TESTING AIDS CONSERVATION

LaMotte Soil Testing Service is the direct result of over thirty years of extensive cooperative research. All LaMotte Methods are approved procedures, field tested for accuracy in actual plant studies. These methods are flexible, and are capable of application to all types of soil with proper interpretation to compensate for special local soil conditions.

Outfits can be furnished for specific nutrient tests, or in combinations of tests to meet requirements. A copy of the LaMotte Soil Handbook is supplied with each outfit.

Literature and recommendations on soil testing equipment will be sent on request. No obligation.

La Motte

Chemical Products Company

Dept. S&W, Chestertown, Md. U.S.A.

California Chapter will hold its annual meeting January 25-27, 1962, in San Diego. At the July 11 meeting of the San Diego section of the chapter, Frank Brooks, recently returned from a tour of duty in Spain, showed his excellent set of colored slides.

North Carolina Chapter newsletter report indicates that 409 farm pond owners in that State cooperated with the chapter's Hugh Bennett Pond Project. Cooperators allowed individuals to fish in their ponds upon purchase of a $1 ticket. The funds raised in this way are to be used to establish a Hugh Hammond Bennett Professorship in Soils at the North Carolina State College. Preliminary information indicates $3,079 have been secured from this project in its initial year. Plans for making this a yearly chapter project are being considered.

Central Arkansas and Ozark Mountain Chapters (Arkansas), already on the Honor Roll (see page 242), sent an additional several hundred dollars for the *Society's* Building Fund just before the JOURNAL went to press.

Hoosier Chapter (Indiana) completed incorporation proceedings on August 19.

Nebraska Chapters will hold their annual meeting November 17 and 18 at the Kellogg Center in Lincoln.

Egyptian Chapter (Illinois) members enjoyed a tour of the Dixon Springs Experiment Station at Robbs prior to their regular meeting on June 9.

Ohio Chapter reports favorable experiences with two types of awards that are a bit out of the ordinary. A $25 savings bond is awarded the chapter member who is the author of the best article published during the year. Another award available to chapter members is a $25 savings bond given to the individual who presents the most outstanding paper at the annual meeting.

Iowa Chapter will hold its annual chapter meeting at the Pine Lake County Club in Eldora on October 27.

NO NEEDLESS DIGGING! NO GUESSWORK!

Find Underground Pipe or Tile Easily, Quickly!

Soil conservationists, farmers and tilers from coast to coast are now locating underground field tile, pipes, tanks, culverts, etc. without unnecessary and costly digging. This lightweight pipe locator is so easy to use, too. Exclusive ring point with smaller diameter rod slips through even hardest soil to probe underground. High quality steel rod lasts for years.

FREE TRIAL OFFER

Underground pipe locator in standard ⅛" rod, popular 54" length, sent postpaid for only $2.85. Return within 10 days for full refund if not satisfied. Special quantity discounts available. Also FREE literature sent on our famous Farm Rod Tile Cleaner.

Roto-Rooter Corporation
301 University
Des Moines 14, Iowa

I'm enclosing $2.85. Please send me one (1) Underground Pipe Locator for ten day trial.

Name .....

Address .....

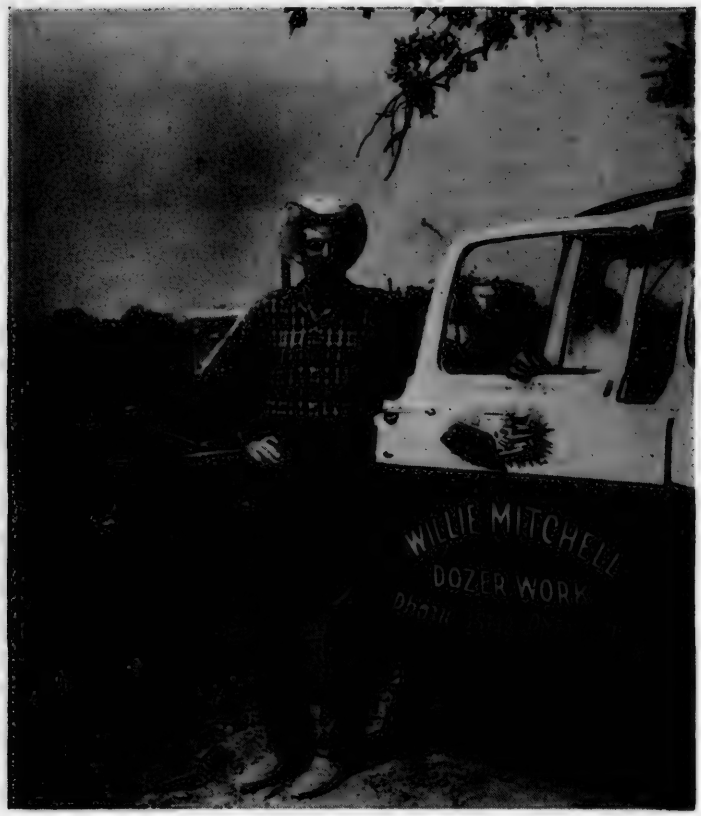
City ..... State .....

The establishment of the demonstration area is a fine example of cooperation. John J. "Jack" Paschke, area soil scientist and chairman of the committee, has had the full support of Minott "June" Silliman, area conservationist, and his staff. The Kankakee Soil Conservation District Board has approved the project and Reece Ayers, work unit conservationist, has helped a great deal. The Conservation Education Division of the State Department of Public Instruction covered the cost of constructing the pond. The pipe under the dam was furnished by the State Division of Parks. The multiflora rose seedlings were supplied by the State Department of Conservation and the wildlife planting stock by the Soil Conservation Service. Dr. D. J. Strickler, head of the biology department, Olivet Nazarene College, helped stock the pond with fish and will supervise that part of the demonstration. The contractors who worked on the job have given much more than full value for their fee.

The committee hopes to expand the area into a completely controlled small watershed project in the future.

—ERNEST D. WALKER

New Jersey Chapter members and guests participated in a spring tour on May 20. The 70 persons in attendance learned about the relation of conservation practices to the geologic formation of southern New Jersey. Included on the tour was a bus load of students from the Philadelphia campuses of Pennsylvania State University and Temple University.



"My new D6B does at least 30% more work than my former D6!"

And that's really saying a lot! For Willie Mitchell, Perrin, Texas, had operated his dependable D6 thousands of hours and figured it was the best and most productive of all tractors in its class.

He was right—until along came the new D6B. And when he saw what the new D6B would do—how much easier it was to operate—how much less servicing it required, he sat down and did some serious figuring.

He came to these conclusions: he stood to benefit at least three ways. (1) In work that he took by the job, he could bid for the same total price as always—or a little less—and come out ahead because of the much greater productivity of the new D6B. (2) On hourly work, he would be justified in charging more per hour, based on the D6B's greater productivity. (3) General costs would be lower, including time and grease for rollers, servicing the oil bath air cleaner.

Just how well the D6B has lived up to his expectations after more than a year of service, is told in Willie Mitchell's statement: "This new D6B has proved to be a lot cheaper to operate, more comfortable and has much more lugging ability. I've looked at them all and don't think the new D6B can be beat. I've found the D6B best—takes less oil, less servicing. I like the idea of buying only one type of oil for both crankcase and transmission, too. I'd say the D6B does at least 30% more work than my previous tractor!"

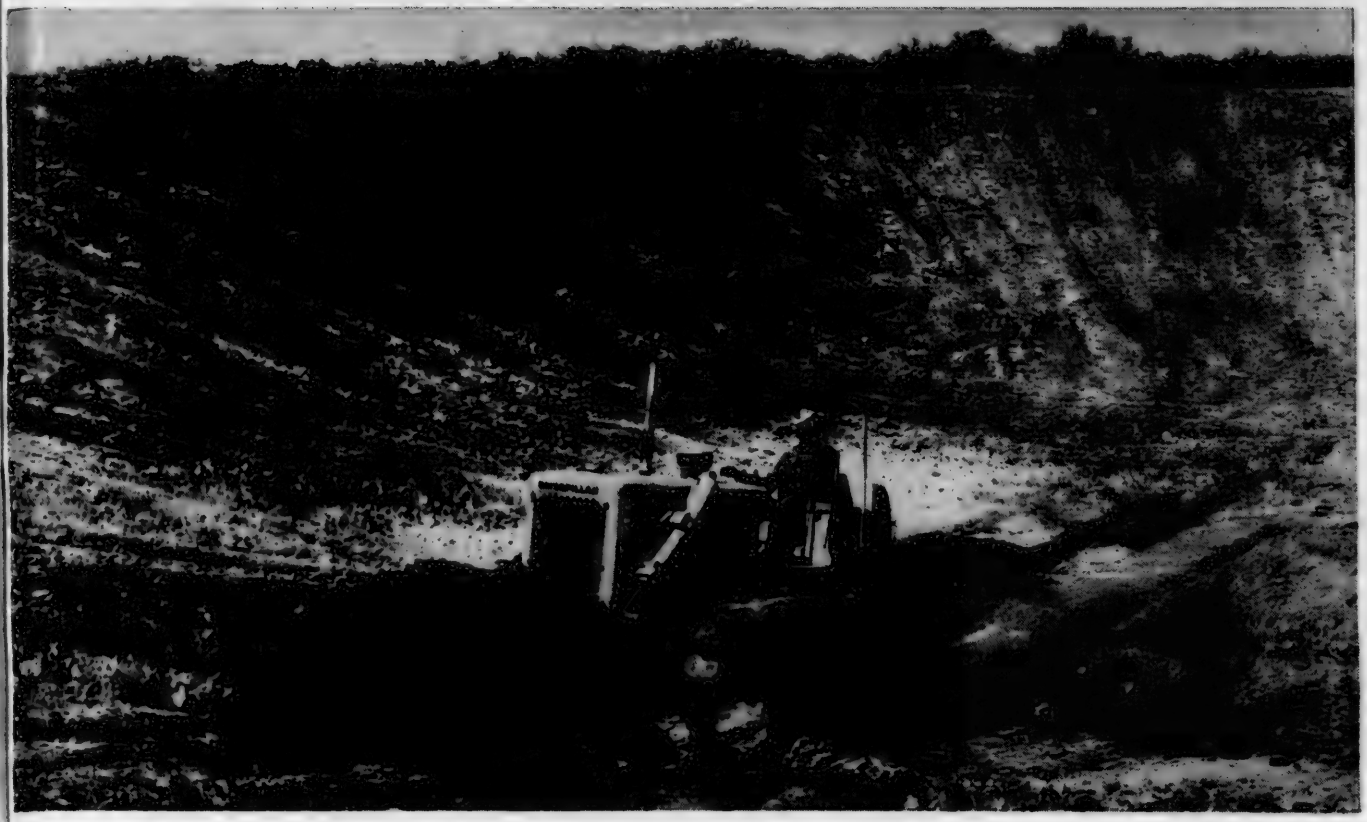
Mitchell's farmer-customers agree, too. They've kept him mighty busy with his new D6B. In the first 5 months of operation, he worked his machine for more than 1050 service meter hours. During busy times he averaged one farm pond or stock tank per week, plus smaller jobs of field terracing, oil field work, etc.

Let's look at the reasons for the D6B's greater productivity:

ENGINE HAS 25% MORE LUGGING ABILITY than previous D6s. The D6B has the extra "push" to keep going through tough spots that formerly required downshifting—gives that extra thrust to handle bigger loads. It all adds up to more work done, more yards of earth moved, more land cleared.

D6B MINIMUM SERVICING LETS YOU START TO WORK FASTER—for example, D6B LIFETIME lubricated rollers and idlers never need servicing until rebuilt. Servicing dry-type air cleaner takes less than five minutes . . . no messy oil, solvents or brushes. Just check fuel and oil, start her up and go!

D6B HELPS YOU WORK MORE 60-MINUTE HOURS—24-volt direct-electric push-button start-



ing is available or in-seat independent gasoline engine starting . . . either one lets you get off to a fast start in the morning. And you're comfortable aboard the D6B; you'll feel better all day long—take fewer breaks—keep running at full capacity right up to quitting time. You sit in a roomy seat that fits you because it was built for you—plenty of padding where it counts—back, seat, sides. Controls are positioned for easy and natural operation—all within easy reach.

D6B LETS YOU HANDLE MORE JOBS WITHOUT HAND LABOR—for example, a new integral hydraulic system provides a choice of circuits to operate several tools at once, if you wish—bulldozers, dozer tilt cylinders, tool bars and rippers. New tilt cylinder equips the dozer for more and tougher jobs—tilt the blade on-the-go to grub out stumps, rough-in slopes, etc. And, of course, there is a variety of tools to match your needs—clearing tools, undercutters, root plows, rakes, winches, cranes, and others. All are available at your Caterpillar Dealer. See him for all the facts, backed by a demonstration.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

BRIEF FACTS ABOUT THE D6B

Drawbar HP	75
Flywheel HP	93
Travel Speeds	5 forward up to 6.6 MPH
	4 reverse up to 6.2 MPH

Cat Diesel Engines burn No. 2 furnace oil, premium priced fuel not required.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Needed by 1975: Over 100 million additional farm acres under soil conservation—thousands of water retention structures.

FREE LITERATURE
Caterpillar Tractor Co.
Peoria, Illinois
Dept. JSW-91

Please send me the following literature:

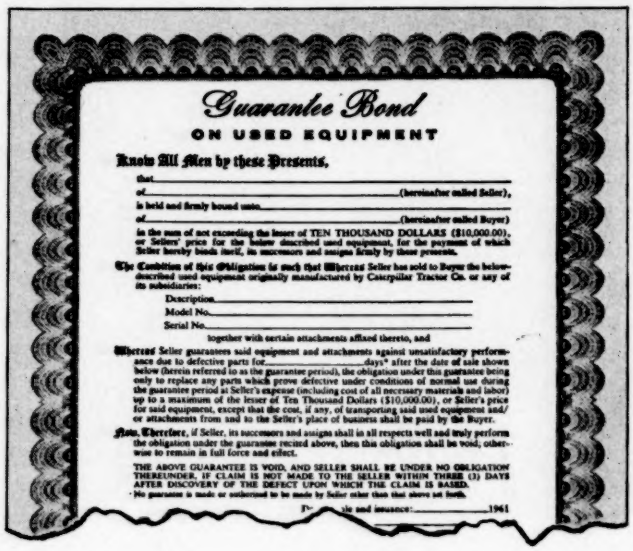
☐ "Partners" ☐ Farm Ponds
☐ Reap the Benefits of Soil & Water Conservation

Name_____

Address_____

City_____ State_____

This Bond Is an Investment in You



Guarantee Bond

ON USED EQUIPMENT

Know All Men by these Presents,

that _____

of _____ (hereinafter called Seller),

is held and firmly bound unto _____

of _____ (hereinafter called Buyer)

in the sum of not exceeding the lesser of TEN THOUSAND DOLLARS ($10,000.00), or Sellers' price for the below described used equipment, for the payment of which Seller hereby binds itself, its successors and assigns firmly by these presents.

The Condition of this Obligation is such that Whereas Seller has sold to Buyer the below-described used equipment originally manufactured by Caterpillar Tractor Co. or any of its subsidiaries:

Description _____

Model No. _____

Serial No. _____

together with certain attachments affixed thereto, and

Whereas Seller guarantees said equipment and attachments against unsatisfactory performance due to defective parts for _____ days* after the date of sale shown below (herein referred to as the guarantee period), the obligation under this guarantee being only to replace any parts which prove defective under conditions of normal use during the guarantee period at Seller's expense (including cost of all necessary materials and labor) up to a maximum of the lesser of Ten Thousand Dollars ($10,000.00), or Seller's price for said equipment, except that the cost, if any, of transporting said used equipment and/or attachments from and to the Seller's place of business shall be paid by the Buyer.

Now, Therefore, if Seller, its successors and assigns shall in all respects well and truly perform the obligation under the guarantee recited above, then this obligation shall be void; otherwise to remain in full force and effect.

THE ABOVE GUARANTEE IS VOID, AND SELLER SHALL BE UNDER NO OBLIGATION THEREUNDER, IF CLAIM IS NOT MADE TO THE SELLER WITHIN THREE (3) DAYS AFTER DISCOVERY OF THE DEFECT UPON WHICH THE CLAIM IS BASED.

No guarantee is made or authorized to be made by Seller other than that above set forth.

Executed and issued: _____, 1961

Signed by your Caterpillar Dealer, this bond gives you up to $10,000 worth of machine dependability

Bonded Buy means guaranteed machine dependability. You can get a completely-checked, used Cat-built machine that has the Cat Dealer's confidence and guarantee, PLUS this bond from Lumbermens Mutual Casualty Company that backs up your machine with as much as $10,000 worth of parts and labor for the period you and the dealer agree upon.

See your dealer. Read the bond. Check the details. This guarantee can apply on your next used machine. And you pay no extra premium for this assurance. Dependable Bonded-Buy machines are priced right—and your Cat Dealer offers terms to match your needs. Call him or see him soon. Do business with the man whose business is built on dependability.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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NEWS OF MEMBERS

Omer J. Kelley has joined the Science Department of Stanford Research Institute's Southern California Laboratories in South Pasadena as manager of the Agricultural Research Center. Dr. Kelley was formerly chief of the Northern Plains Branch, Soil and Water Conservation Research Division, Agricultural Research Service. **Dr. C. E. Evans** has been named to succeed Kelley. Evans was chief of the Southwest Branch, SWCRD, with headquarters at Riverside, California.

Boyd O. Fisher, regional engineer for the Eastern Region, U.S. Forest Service, has been transferred to Denver, Colorado, as regional engineer for the Rocky Mountain Region.

R. G. Downes, chairman of the Conservation Authority of the State of Victoria, Australia, has recently been named chairman of the Committee on Soil and Water Conservation of the International Union for Conservation of Nature and Natural Resources.

John L. Merrill has been appointed as head of the Ranch Management Training Program at Texas Christian University.

Albert S. Fry, chief of the Hydraulic Data Branch, Tennessee Valley Authority, has retired after 28 years of service with that agency. A contributor to the JOURNAL, he was also active in the East Tennessee Chapter of the Society. Succeeding Fry is **James Smallshaw** who has been assistant chief since 1960.

Firman E. Bear, charter member and past president of the *Society,* gave the first Louis Bromfield Memorial at Malabar Farm for those who attended the Third Institute on Soil, Food, and Health Relationships. The Louis Bromfield Gold Medal was awarded to Dr. Bear for his accomplishments in the promotion of soil and water conservation through the use of the media of conservation.

Friends of **Herb Plambeck,** farm service director for WHO radio and television stations in Des Moines, Iowa, surprised him with a splendid party on August 28, the anniversary of his 25th year of employment in the farm department of WHO.

George T. Thompson, formerly chairman of the Conservation Authority of Victoria, Australia, is spending approximately six months observing soil and water conservation programs in the United States.

Individuals attending the *Society's* annual meeting at Purdue University under the auspices of the International Cooperation Administration included: **Dr. Kaza V. S. Satyanarayana** of India, **William H. Andrews** of Tanganyika, **Samuel N. Bandawe** of Nyasaland, and **Reginald P. Furber** of Nyasaland.

Fred M. Packard has been named as director of the National School of Forestry and Conservation. He succeeds **Charles H. Stoddard** who resigned to join the technical review staff of the Secretary of the Interior.

M. L. "Duke" Dumars, a member of the JOURNAL's editorial board, has been named as director of the Information Division, Agricultural Stabilization and Conservation Service.

Kenneth L. Bowden, a doctoral candidate in the Conservation Department, School of Natural Resources, University of Michigan, has accepted a position with the Division of Watershed Management, Pacific Southwest Forest and Range Experiment Station at Berkeley, California. Bowden is carrying out a study to evaluate factors contributing to flood peaks in northern California wildlands.

U.S. Secretary of Agriculture, Orville Freeman, has appointed, among others, the following *Society* members to the U.S. Department of Agriculture Soil and Water Conservation Advisory Committee: **Dr. W. L. Henning,** Pennsylvania Secretary of Agriculture; **T. G. Ragsdale,** Virginia farmer; **DeWitt Nelson,** director of the California Department of Natural Resources. *Society* members continuing to serve on the committee include: **Firman E. Bear, A. D. Holmes, Wayne Criddle, Carl I. Peterson** and **Arthur Sullivan.**

Cecil W. Chapman, newly elected *Society* Council member and state conservationist for the Soil Conservation Service in Georgia, has been appointed by President Kennedy as a member of the U.S. Study Commission, Southeast River Basins.

Glenn B. Van Ness, a veterinarian with the Animal Disease Eradication Division, Agricultural Research Service, has been transferred from Beltsville, Md., to the National Animal Disease Laboratory at Ames, Ia.

Elmer Sauer, immediate past president of the *Society,* is now with the Illinois Extension Service, Urbana, Illinois. He is working with the Rural Areas Development Program.

DEATHS

Roger P. Lathrop, Primghar, Iowa, died of a cerebral hemorrhage on August 11. A work unit conservationist, he was a charter member of the *Society.*

R. Henry Morris, III, Philadelphia, Pennsylvania, died on August 22 at the age of 64. In May 1961 he retired as assistant to the director of the U.S. Department of Agriculture's Eastern Utilization Research Laboratory at Wyndmoor.

R. S. Ihlenfeldt, Madison 5, Wisconsin.

John N. Gayle, Lake Charles, Louisiana, died on March 3.

Your two effective weapons against erosion

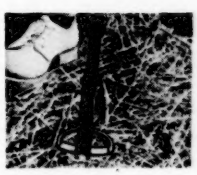
BEMIS MULCHNET

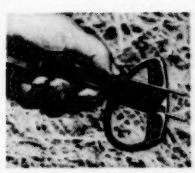
For holding straw or other mulch on critical slopes, on forest-tree nursery beds, etc., while seeds germinate. MULCHNET is a wide-weave, twisted-paper fabric with excellent weathering qualities. Retains 50 to 75% of its tensile strength when wet. Selvage edges and center yarns (where staples are placed) are mildew-treated and reinforced for longer life.

MULCHNET is surprisingly low in cost—only about 4¢ per square yard. Fast and easy to apply. See the stapling tool illustration.

BEMIS EROSIONET®

For use without mulch—holds seed in bed and controls erosion on slopes and in shaped ditch bottoms. A twisted-paper fabric, its closely woven, square mesh forms millions of tiny dams which hold seed and sprouting grass firmly in place. EROSIONET also catches and holds moisture, thus aiding germination. Easy to apply; anchored with staples. Bemis has manufactured EROSIONET for erosion control and landscaping for more than 25 years.





MULCHNET AND EROSIONET ARE EASILY AND QUICKLY APPLIED

Wire staples and stapling tool designed especially for MULCHNET and EROSIONET make application quick and easy. The tool is quickly loaded and the material is stapled without stooping.

MAIL THIS COUPON TODAY

Bemis Bro. Bag Co., 111-X N. 4th Street, St. Louis 2, Mo.

Please send test-size sample roll of
MULCHNET ☐ EROSIONET ☐

*Name*_____

*Firm*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

Top efficiency means "Total Traction" and that means TRACTION SURE-GRIP!

The "action close-ups" tell the story of the top efficiency that comes with "total traction." Every turn of the wheel brings you closer to the end of the job. Fuel-eating, time-eating slippage is reduced to a minimum.

But the TRACTION SURE-GRIP cuts your costs in other ways, too.

INCREASED TIRE LIFE, for instance. Exclusive Triple-Tough Cord – triple-tempered by precise Tension, Temperature and Time – brings you new freedom from cracks, bruises, buckle breaks and other costly tire life shorteners.

ON-THE-FARM SERVICE also is a time- and money-saver. Expert on-the-spot repairs or "free loaners" minimize lost motion. And if a new tire is needed, you can make the best deal in town right then and there.

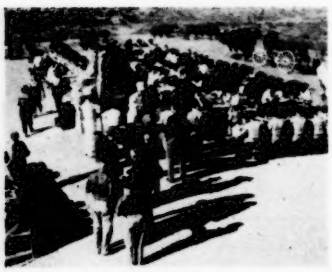
A phone call is all it takes to bring a Goodyear Dealer up to your door and your *operating costs down* to a new low. Goodyear, Farm Tire Dept., Akron 16, Ohio.

See how it works!

THE START: TRACTION SURE-GRIP thrusts solidly against walls of earth behind its lugs—a greater area to utilize the torque because the lugs are extra long, extra deep and ruler-straight.

THE FIRST FORWARD MOVE: Now the lugs, wider apart at the tire center than at the shoulders, actually wedge the soil between them for a vise-like grip that cuts way down on slippage.

THE SHOULDERS ADD THRUST: The TRACTION SURE-GRIP lugs, running right down the sidewalls, add many extra square inches of traction area. This thrust at the sides of tire, as well as under it, results in "total traction."



WIN A WONDERFUL STAY AT THE WIGWAM—Once again Goodyear is happy to announce the continuation of its long association with the Soil Conservation District movement. The 9th Annual Goodyear Soil Conservation Awards Program is now open. And *you* can win an *all-expense-paid trip* to that famed luxury ranch The Wigwam, Litchfield Park, Arizona. Check your local Soil Conservation District Office for full details, today.

More farmers prefer Goodyear tractor tires than any other kind

Lots of good things come from

GOODYEAR

Sure-Grip—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio